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Bulletin

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BULLETIN

OF THE

American Bureau of Geography

VOL. II MARCH, 1901 No. 1

OBSERVATIONS UPON THE PRESENT STATUS OF THE TEACHING OF GEOGRAPHY

BY WILLIAM A. MOWRY, HYDE PARK, MASS.

No argument is needed to show that Geography is an important branch to be taught in all schools. It is one of the most prominent of the so-called "information studies." It has to do with daily life. With the younger children it begins with the known and proceeds outward and onward almost infinitely in many directions, bringing up and making the child acquainted with that which heretofore was unknown, but which now becomes of real interest and of great value. Geography, when properly taught, is a many-sided science. It should deal with the structure of the earth, its varied surface, its mountains, hills, plains and valleys, its river basins, lakes, and the various natural features of salt-water bodies. It must unfold to some extent the common phenomena of meteorology. It must give information concerning all sorts of vegetable life, natural and cultivated. It must tell us how and where we get our food and clothing and habitations. It should explain to us animal lifein all its variety, with the great differences produced by variety in climate. It should show what truth underlies the statement of the old lady who said that to her mind it was a wonderful indication of divine providence that large streams usually flow by large cities. Its most important function lies along commercial lines.

It is easy to see that this study may be readily adapted to elementary instruction, and equally well to the secondary schools and in its higher, scientific aspects to college courses. It will at once appear plain and important that the right phases of the subject, and only such, be presented to the younger children, that the proper lines be followed in the secondary schools, and that the true scientific treatment adapted to the conditions should be observed in the college curriculum.

It has for many years seemed strange to me that the colleges should spend so much time upon physics and chemistry, upon geology, mineralogy, astronomy, and various other branches of natural science, while at the same time there could scarcely be found in the country a college which had in its faculty a professor of geography. These other sciences are, of course, important, and must not be neglected, but perhaps scarcely one of them is of so much scientific interest or real practical value to every day life as geography. It is one of the favorable signs of the times that our new education has so modified this state of affairs that colleges and universities are now establishing such professorships, and introducing full scientific courses in this important subject.

The general absence, heretofore, of this study in our higher institutions of learning, doubtless has had much to do with the unscientific and unpractical school books which have now been in use for an entire century. Rev. Dr. Jedidiah Morse may well be called "The Father of American Geography." He published a school text-book upon this subject as early as 1784. It was called "*Geography Made Easy*," and has been described as the first work of that character published in the United States. His larger work, "*American Geography*," was first published in 1789. This consisted of one volume, octavo, of 534 pages. It was confined chiefly to a description of America. Four years later it was enlarged and published in two volumes of 1250 pages, with the title "*The American Universal Geography*." The next edition was three years later, when the work was increased to 1500 pages. A fourth edition appeared in 1801 and 1802 with many changes, much new matter inserted and obsolete or less important matter omitted. This was still further revised and a new edition published in 1805. It was a great work for the time and was held in high esteem.

William Winterbottom, an English clergyman, while in prison in London in 1795, published four volumes, entitled "*The History* *of America.*" This "History" was largely geographical and extensive portions of it were taken bodily from Morse's geography mentioned above. In 1793 Michael Adams, of London, published a large volume of nearly a thousand pages, small quarto size, illustrated with many copperplate maps and cuts, entitled "*The Royal System of Universal Geography;* Containing Complete, Particular and Accurate History and Descriptions of Europe, Asia, Africa and America, as Divided into Empires, Kingdoms, States, Republics, Governments, Continents, Islands, Oceans, Seas, Rivers, Gulphs, Lakes, etc., etc., Including all the New Discoveries; Written and Compiled by Michael Adams, Esquire, assisted by many Gentlemen Eminent in the Science of Geography." This great work was dedicated to "His Britannic Majesty, George IIId." The preface begins with this sentence:

"The study of universal geography is now become the most fashionable as well as the most rational amusement of the present polite and enlightened age." He further says in his preface:

"Calculated to please as well as to instruct it is not at all wonderful that geography should hold a principal rank among those sciences which are the delight of a refined age, and tend at once to expand the mind and enlighten the understanding."

After the year 1800 the study of geography gradually crept into the public schools of America. Various small treatises were published. One of these, entitled "A Short Introduction to Geography and Astronomy, Second Edition, Improved," was published in 1808 at Burlington, Vt. The little book is comprised in forty-six pages, thirty-one upon geography and fifteen upon astronomy, the length of each page being four and one-half inches, and the width two and one-half inches. The entire book is in the form of question and answer, and it begins in this way:

Section I.

Q. What is geography?
A. It is a description of the earth.
Q. Of what substance is the earth composed?
A. Chiefly of two elements, viz., land and water.
Q. By what name is the earth called?
A. It is called the terraqueous globe.
Q. Why is it called the terraqueous globe?

A. It is so called from two Latin words, *terra* and *aqua*, the former signifying land, and the latter water.

Q. Why is the earth called a globe?

A. Because of its shape.

Q. What is its shape?

A. The earth is round like a ball.[1]

And so the questions and answers proceed, discussing the size of the earth, oceans, seas, bays, gulfs, straits, lakes, rivers, etc. It then considers boundaries and talks about North America and Europe, monarchies, aristocracies, and democracies, and names the political divisions of Europe, Asia, Africa, North America and South America with their capitals. This book was used in school by my father, in the year 1814.

Mr. S. G. Goodrich, (Peter Parley), published geographies for the schools from 1834 onward. A decided impetus to the study was given by *Olney's Geography and Atlas.* The first edition of this work was printed in 1828. It was very soon accepted as a standard work and for a period of about thirty years it was in extensive use thruout the United States. It was repeatedly revised and enlarged and ran thru nearly one hundred editions. A single edition sometimes numbered eighty thousand copies. Millions of copies were sold and the popularity of Olney's geography has been surpassed perhaps only by that of Webster's spelling book.

It is not necessary to speak of the recent text-books in geography and the great improvement which has been made in the modern method of presenting the subject to the pupil's mind. After giving full credit to these later books, it may still be questioned whether any of them are entirely satisfactory, or whether we have yet attained to a model text-book or an adequate treatment of the subject.

It may naturally be expected that with the far greater attention given to geography in this country at the present time we shall soon have authors raised up who will be able to make text-books suitable to the different grades, practical on the one hand and scientific on the other.

Karl Ritter was a Geographer; Arnold Guyot was another. When Professor Guyot published his course of lectures on physical geography under the title of "*The Earth and Man*," a little more than fifty years ago, he turned the attention of American teachers to the true theory of geography. The principle is now generally admitted in the teaching of history that in the schools only that should be taught which shows the development and elevation of mankind. It is also now generally conceded that the geography which should be taught in the public schools should comprise that, and that only, which relates to the earth as the abode of man. All those portions of the earth's surface which have no relation to mankind should be eliminated from the elementary book on geography. The pupils should have placed before them those facts and those principles in geography which have reference to the earth as the home of the human race. This should be the key note to all modern geography.

---

[1] "This is not truly the case for the earth is found to be about thirty miles further in diameter from east to west than from north to south." [A foot note from the same book.]

Of course the text-books should observe carefully the fundamental principles of pedagogical science. For instance: We should begin with that which is known and proceed to that which is unknown. We should begin with that which is simple and proceed to that which is complex. We should begin with the individual and proceed to generalizations later. We should begin with the concrete and proceed to the abstract. In this way we shall begin with the practical and descriptive science and end with the theoretic principles of geography. It will never do with children to begin as formerly with the centre of the solar system as the initial point and so develop the planets until the scheme finally includes the earth. It will never do to teach geography to children by analysis, that is, beginning with the earth as a unit and dividing and subdividing it by terms applicable to both natural and political divisions.

Let us hail with joy the increased attention now given to this subject. Let us labor and let us pray for the time to be hastened when we may be able to put into the hands of the school children text-books thoroly fitted for their purpose; on the one hand practical, and on the other hand scientifically correct; and let us devoutly wait, impatiently tho it may be, for teachers in all our schools so thoroly taught in geographical science that they may be able to teach successfully those facts and principles which we now denominate geography. Let us do all in our power to hasten the day when this study shall become, as it ought to be, as charming and delectable to the children as any branch in the public school curriculum.

THE STUDY OF COMMERCIAL GEOGRAPHY IN COMMON SCHOOLS

BY JOHN N. TILDEN, PEEKSKILL, N. Y.

In the preface to a "*Modern Geography*" by Nathaniel Huntington, published at Hartford in 1835, the following paragraphs are found: "The science of geography is an essential branch of elementary education, and calculated to awaken and cherish in the juvenile mind that spirit of curiosity and inquiry which, under due regulation, often leads to the noblest and happiest results. Nor is it a theme unworthy of mature minds, nor beneath the attention of men of learning and taste, nor important merely as a source of mental diversion and entertainment; on the contrary it opens a wide field for improving and profitable contemplation, is in many respects connected with the general circle of the sciences, and contributes more than is commonly supposed, to the formation of the scholar, the man of business, the patriot, and the philanthropist.

"One grand reason why multitudes are found so contracted in their sentiments, sympathies, and operations, is that their education has been very limited and defective. They have been accustomed to look only near home, or upon their own gratification, interest or party, instead of extending their intellectual and moral vision abroad, and considering their relation to the whole human family.

"Many of our youth would aspire and attain to greater and nobler achievements, if their minds were, in due season, cultivated and enlarged by an acquaintance with the state of the world and with the diversified character and condition of its inhabitants."

The foregoing extract expresses sentiments that are no less true today than when written more than half a century ago. It is probable that the full value of geographical study is best appreciated by its specialists and those who are engaged in teaching the subject, for while no educator will for a moment deny or belittle its importance, yet its broad scope and wide usefulness as an element of practical education has not, in the writer's opinion, been sufficiently recognized. No other branch of elementary education is of a more progressive character than geography. No other branch is more constantly developing and enlarging, and no better evidence of its interesting and valuable field is needed than to consider how many articles of a geographical character find their way to the columns of our best periodicals and newspapers.

Reports of explorations; narratives of journeys; statements of productions; extension of railways and canals; building of steamships; all these topics, as well as others relating to the activities of mankind, in so far as the productions of the earth and their exchange is concerned, have a direct geographical bearing and should have a place in the study of this useful and interesting subject.

There has been, for some years, a growing conviction that in the study of geography much time has been given that is less fruitful of good results than should be expected. In this connection it may be said, that the study of geography is ordinarily begun at an age when the child's mind is too undeveloped to learn from reasoning or comparison. Memorizing and object lessons are the two ways in which the leading facts in geography must be fixed in the pupil's mind. Much of that part of geography which is astronomical and physical is too difficult of comprehension to be well understood by ordinary children at the age when these things are usually set before them. Many of us will readily acknowledge from our own experience that we studied and learned "by heart" the geographic definitions about latitude, longitude, change of seasons, tides, equinoxes, etc., but we did not understand them until later on in our studies when we were better able to compare, reason and adapt correlated knowledge.

This brings us to the consideration of the special subject of this paper, "The Importance of Commercial Geography in the Common School." Few of the common school pupils will have the opportunity for what is known as a liberal education; and the great question is to give these children such fundamental training as will be of the most practical value, and at the same time awaken in them a desire to become well informed, if not well educated. That the study of commercial geography is well calculated to promote a spirit of inquiry and an interest in the world's affairs appears almost self-evident, when we remember how fruitful this department of geography is in striking object lessons.

Take the items of an ordinary dinner, and follow them in story and illustration from their origin to the place of consumption. There is flour from the wheat fields of the Northwest, ground in the mills at Minneapolis, and freighted by rail or water to the various towns where it is finally distributed to the consumer. Sugar from the beet or cane would make a very interesting topic for a fine object lesson, to be illustrated by photographs of Hawaiian cane fields, sugar refineries and sugar beet farms, while the fact that beet sugar is somewhat harder than cane sugar, and therefore less soluble and consequently seems less sweet, would so quickly fix itself in a young child's memory as to abide; and the whole subject of sugar, so dear to the childish palate, would be invested with new and lasting interest. Pepper from Spain; salt from the ocean, or from Syracuse or Saginaw; vanilla from Central America; where and how butter is made; all these would be items of interest. Even the teacher might be surprised to learn that the yearly value of dairy products in the United States amounts to $500,000,000, a sum greater than the entire value of the wheat crop.

Tell the story of tea, coffee, etc.; and again the story of the child's own clothing; and the furniture of the house. The school room clock with its steel spring made from iron, mined, smelted and changed into steel, refined and tempered until its value by weight is greater than that of gold, would make a fascinating story to be supplemented by the fact that the United States now leads the world in the production of iron, and her locomotives and bridges go to Africa, China, and to other remote quarters of the globe.

The field for object lessons of the greatest interest and value is unlimited. Show the pupils such an object of every day observation as a freight train going toward the seaboard with grain or cattle; and follow these raw products of the soil thru their various transitions, until utilized as finished products by man, for food, clothing, medicines, etc., which will be returned by the same cars, perhaps, from the different factories and shops. Are there, in the vicinity, manufacturing establishments? The pupils should be shown what is done, and how human labor adds constantly to the value of the raw materials. Is it possible to secure articles of familiar use, undergoing processes of development? *Have a museum* *for the school; it is surprising how many interesting things can be collected by a little effort and with little expense. The best feature of this plan is that it never fails to interest and instruct.*[1]

Thus may geography come to have a living, daily meaning. A pupil may memorize the location of the various forms of land and water; but long after he has forgotten where the Cape of Guardafui and the Gulf of Carpentaria lie, he will still retain the main facts of the object lessons in commercial geography, taught and illustrated as heretofore outlined. The study will retain a continuing interest, for it deals constantly with the vital activities of the world.

Take for instance the topic of petroleum, which has, since its discovery in 1859, grown to be an item of world-wide importance in commerce and a familiar article in almost every household in civilized countries. When first transported in barrels, the cost of shipping from Titusville, Pennsylvania, to New York, and returning the empty barrels was $5.55 per barrel. The first step in reducing the cost of transportation was by constructing cars with wooden tanks, and later iron tanks took the place of wooden ones, but in 1881 a line of pipe was laid from Titusville to the seaboard. Since then other pipe lines have been built, so that there is now an aggregate length of over two thousand miles of pipe, thru which the mineral oil is distributed from the oil regions to New York, Philadelphia, Baltimore, Buffalo and Cleveland.

These pipe lines have reduced the cost of distributing the oil to about forty-five cents per barrel. From the seaports the oil is shipped in bulk in tank steamers or in barrels to the remotest regions of the earth, and the annual export has reached a value of nearly $60,000,000. The development of cheap transportation has greatly increased the use of oil for domestic purposes, and shows that the concentration of capital for the production and distribution of staples may, and often does, benefit consumers by the reduction of prices.

From these plain commercial facts ask the class to name as many articles as possible made from petroleum, and their uses. It is doubtful if the members of the class would be aware that the brilliant and beautiful aniline colors are derived from mineral oil, or that antipyrin, phenacetin and other valuable remedies used by physicians take their origin from the same source.

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[1] The italics are our own.—EDITOR.

Others of the great staple articles of commerce may be similarly treated; and to no teacher need the fact be emphasized that by illustrations and object lessons of this and of a similar nature, not only is the interest of pupils aroused but the most useful and practical facts are firmly fixed in their memories. It must then be admitted that commercial geography is not only feasible as a common school topic of study, but it is interesting and valuable. It is especially useful in that it deals with the practical and vital relations of the world's work with mankind. It shows, as no other study can, the interdependence of nations for the necessaries of life as well as its luxuries.

No more striking illustration of this dependence of nations one upon another can be found than in the present condition of affairs in China. For centuries China has barred herself against the encroachments and advances of foreigners, under the supposition that she could exist without any intercourse with the outside world; yet her conservatism and indifference to the progress of other nations caused her defeat in the war with Japan, and has led gradually but surely to the present convulsion, that will either rend and destroy her as an independent nation or start her along in the march of modern progress.

Japan yielded, contrary to her inclination, when Commodore Perry entered her waters with his warships; and her progress from that time, in wealth, commercial development and in power has been marvelous. No nation on the earth can now prosper without commercial relations with other nations.

The United States now leads the world in the production of four of the great necessaries of life: **Coal**, for heating, motive power, and light—her annual output of this article amounts to over $200,000,000; **Food Products**, which are exported to the value of over $175,000.000; **Cotton**, for clothing material, while having a large consumption at home, is also supplied to other nations to the value of over $200,000,000 yearly; and **Iron and Steel**, without which neither tools, machinery, modern steamships, nor railways and their equipments can be produced. The supremacy of the United States in the production of these four staples is alone quite sufficient to place her in the forefront of commercial nations; and in fact when the total value of exports and imports is considered, the United States stands fourth among the nations, Great Britain, Germany and France alone surpassing us in the order named.

Do we need any more cogent argument in favor of teaching our boys and girls the essential facts of the world's commerce than is shown by the foregoing facts, as well as in the rapid development of our export trade, which in 1899 amounted to the enormous sum of $1,203,931,000.

The great trading nations of Europe have long ago discerned the importance of training their *young men* especially for a commercial life; and we must not postpone the practical value of such education, if we are to maintain the progress already begun.

A good foundation, not only for commercial life but toward an all round training that will make for intelligent and practical living, can be well assisted by the judicious teaching of commercial geography in the common school.

SOCIAL PHASE OF GEOGRAPHY

BY CHARLES C. VAN LIEW, STATE NORMAL SCHOOL, CHICO, CAL.

By the term "Social Phase of Geography", as applied to the subject matter of instruction in elementary schools, we mean all those facts which reveal directly the organization, forces, activities and products of human life. The term can hardly be used in connection with school geography, except in this very broad and rather loose sense. Thus, to the mind of the writer, it naturally includes what we have called industrial, commercial and political geography, and civics; but the phrase is chiefly valuable for including more than these. It comprehends, first, not only facts relating to industry, commerce and government, but a body of related facts which are or may become the bearers of such sociologic and economic ideas as division of labor, specialization of function, competition, coöperation, labor, capital, property, consumption, supply and demand,—not that any of these difficult concepts can be dealt with in school in their abstract form, but that a concrete foundation for them can be laid by developing the complexes of ideas which must underlie them, and in which they are implicit. Second, the term suggests as one of its best services the need of the concrete study of typical social groups, such as the farm, the rural community, or the town. Finally, it emphasizes the value of referring all facts whatsoever, which get into our geographies and which deal with human activities and human life, to their organic places in human society as a whole. In a word, if there is anything in this idea of "Social Phase of Geography" in elementary school instruction, it lies in its power to secure unity in the aims, the method, and the results of geographical study.

If there is any central point of view in all the subject matter which is brought together in school geography from very many different scientific sources, it is certainly to be found in the structure and activity of human life, especially as related more or less directly to physio-graphical conditions. We study a little mathematical geography in order to locate the greater and lesser centers of human action with accuracy upon the face of the earth. We study physiography, climate, meteorology, in a more or less fragmentary way, so as to learn the great physical conditions which environ and in part determine human development. In the same partial and fragmentary way we study geology, mineral wealth, soils and the like, in order to understand somewhat of the raw resources which condition and stimulate human development. Such is school geography; we comprehend in neither case more than partial, imperfect, often fragmentary views of the auxiliary sciences. Yet it is possible for the child to receive from the elementary grades a comparatively extensive and well organized body of knowledge, thoroly practical, and well-related and unified, provided the true point of view can be made emphatic enough to secure unity. This point is summed up in the present organization, forces and life of mankind. In fact with this theme the greater part of the ordinary subject matter of school geography deals. It remains for the future of instruction to realize it more completely by making geography, especially in its foundations, more a matter of observation and sense-imagination and less a matter of verbal memory; by dealing less with discrete facts and more with real units and groups of human life and action; by making the great sociologic and economic conceptions of modern life the guiding principles in selecting and rejecting from the vast storehouse of geographical material, not as explicit conceptions in the instruction before the child is ripe for them, but as always implicit in the subject matter.

Geography is certainly a great informational subject. But in our efforts to have it fortify the child at a thousand points for as many different demands in life, we must not lose sight of the fact that even valuable information getting is limited by the extent of one's sense-experience. The greatest stumbling block in all instruction in geography is the attempt to teach this science with very little or no direct study of its objects. There is yet remarkably little use of experiment, excursion or direct observation. The whole superstructure is attempted by an appeal almost exclusively to memory and imagination upon the basis of chance experience, more or less imperfect, inexact, fragmentary and purposeless, so far as the ends of instruction are concerned; hence it too rapidly becomes a purely verbal superstructure. The child talks a great deal about the colossal undertakings of a commercial nature in our great cities, but is quite innocent of any adequate grasp of the commercial interests of his own environment. Yet the latter are his only means of interpreting the former. In no department of geography is this deficiency more glaring than in that which we are calling social geography.

Every other science has reached a point in its influence upon elementary education which recognizes that before all else must go observational and experimental work; that the ordinary chance experiences of childhood with the phenomena of a science do not offer sufficient foundation for future reasoning upon or with its principles; that therefore these experiences need to be tested, examined, analyzed, multiplied, compared in a thousand ways; that even with an abundance of such enrichment and re-inforcement of experience, always with the ultimate principles of the science in view, only slowly does the child grow into a grasp of the principles themselves. The movement starts with its more emotional phase, the love of nature, the affectionate interest in her phenomena. It utilizes and intensifies this spontaneous interest, which rests upon a variety of instincts in the child, knowing that intimate acquaintance with the commonest facts of nature will follow the gratification and direction of the interest. In the end it is able to divert the interest in the direction of the more thoughtful and logical aspects of the science and of scientific purposes, *sensu stricto*. The prime condition of the integrity and success of this movement from start to finish is abundant, directed and varied contact with reality in the form of sense-impressions. Every subject which rests directly upon sense-realities must learn this lesson from the history of science teaching. Geography is such a subject; no phase of it is more dependent upon a good foundation of sense-realities than this which we are calling social geography.

Every child displays a natural interest in the affairs and activities of the human life about him. His interest in the busy scenes of human action is not second to his interest in nature's objects. His plays and games are for the greater part in imitation of adult human industries and activities; they reveal how much human action impresses him and how common and often minute his observation of it. He is usually ready to lend a hand socially, provided the office required of him is commensurate with his strength and his powers of endurance and application. He is certainly always ready and eager to become a companion in the inspection of some new or strange human scene. Life itself has intensified the social interest in him almost from birth. Yet in this case as in that of any other science, his actual experience with the data of the science still needs objective expansion, multiplication, with the ends of sociologic and economic principles in view. That these added, expanded and tested experiences should make ultimately for a knowledge of some of the principles upon which human society is organized, and in accordance with which it operates and develops, is as essential as that the first-hand information itself be secured. Definite aim is the only thing which will keep such information from being trashy, trivial, fragmentary and unrelated.

Grant that the instruction in social geography must be founded on a thoro study of the object itself, society, and the demand for the liberal use of the school-excursion follows as a logical necessity. Society, its parts, methods, activities, must be re-inspected; its data must be re-arranged and re-related for the child. Again it follows just as logically that no text-book[1] can prepare the teacher for this work except in general terms. She can learn something of the aims and principles which should be implicit in the subject matter from a text; but she will have to work out the problem of her particular environment for herself and in detail This work may and should be undertaken in the intermediate grades, before a study of the remote and foreign social relations is attempted. In these grades no profound sociologic studies or interpretation can be attempted; they are not necessary. Rather let the object, i. e. organized society, be found and studied objectively. In general let the choice and treatment of the subject matter be guided by the interest of the pupils and their capacity to grasp. What the quality and selection of the material of instruction should be further may best be enforced by an illustration, drawn from the writer's present social environment. Limited space requires that the matter be condensed. Touching the town in question the following series of type-studies (but partial as here presented) may be suggested:

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[1] McMurry, Special Method in Geography, *illustrates* selection of subject matter in Social Geography well.

1. The Town as a Trade and Industrial Organism: It lies chiefly between two creeks, three to four miles from their exit from the foot hills of the Sierras, and about six miles from their junction with the Sacramento river. The soil of this section is very rich and productive. During the summer and fall months some of its fruits are to be found in the canning factory of the town, which stands near the railroad. Beside the creek is a mill which converts wheat into flour. It is a quarter of a mile from the freight depot, but is connected with it by a spur of the railroad. On another edge of the town is a branch of the lumber yards of the great Sierra Lumber Co., connected with the distant forests of the Sierras by a great V water-flume down which the lumber is floated to the yards. Other industries ministering to internal social needs are the gas and water companies and electric light companies. One of the latter secures its power by converting the water power of the neighboring creek into electric power while it is yet far distant in the mountains. The town supports a large number of large livery stables for a place of its size. Some of these run stage lines to Orland, and to Oroville, the county seat. All of them must be ready to supply a large demand for means of communication with the surrounding mines, ranches and lumber camps. At one side of the town stands a large state institution materially affecting the business interests of the city. Such are some of the leading observations to be made upon the more prominent features of the town. In addition to this, attention should be drawn to such commoner features as hotels, banks, and mercantile stores and commission and shipping merchants, especially as to their position with respect to each other and to the business needs of the entire place. The commoner trades and their location and interrelation, should not be overlooked. This does not exhaust the material which could be brought into action. The foregoing is sufficient, however, to show that we have to do here with a body of facts, each one of which, taken alone, is of indifferent value, but seen as a part of an organic whole, is thoroly significant. The study is not one of the social

atoms, but of their relations. And since these relations may be presented to the child in terms of concrete or sense experience, they do not lie beyond his power to conceive. The mountain forests, the flume, the lumber yards, and the building needs of the town are together significant of industrial causes, means and methods. The long wagon trains drawn by from six to ten horses or mules, passing between the landing on the Sacramento river and the town, tell of the effort to secure the advantage of cheap river freight rates, and of the competition of the water ways with railways. The central location of the banks, tells of their multitude of services to all the business interests. These interrelations which might be multiplied indefinitely, may all be illustrated objectively, a necessity in these grades. They serve in the end to bring discrete phenomena in the child's mind into a significant picture of a great organism.

But the above study, well worked up and carried out, would not exhaust the possibilities of social geography in this place. After the general concrete view of the social organism, the town as a whole, some of its parts should be treated in the same way in detail. Let us suggest some further types to follow in the above instance.

2. The mill: Essential features of structure, processes, following wheat to flour, means of communication and transportation to outside world.
3. The lumber yards: Position, structure and function of flume; contents, arrangement and work of yard; communication with other human activities.
4. The lighting system.
5. The water system.
6. The public library.
7. The foundry.
8. The town officers, their selection, duties, names, etc.
9. The school system, and others.

Each of these types should be undertaken in detail. In the case of topics 4, 5, 6 and 9, the attention should be directed to the legal status, regulations, powers and limitations, a body of knowledge which makes for good citizenship.

Now the above illustrations, which only partially cover the ground, are merely intended to suggest how, in the mind of the writer, the work of social geography must be undertaken. The above topics hold good for this place only. As before stated, each locality, be it rural community, town, or city, requires a special working out of the problem, one suited to its own features. There is no school which has not its social environment worthy of study as an organism.

When this work is well accomplished, a good foundation has been laid for the grasp and interpretation of social relations lying out of the child's opportunities for direct observation. It should not be forgotten that any adequate study of the commercial and industrial geography which carries the child outside of his immediate environment cannot well overlook the principles which have been advanced above touching social geography. Social geography, above all, must move with the movements of civilization. Now that trusts, combinations, labor organizations, and coöperative enterprises have become recognized features not only of industrial but of social life in the broader sense as well, there is no reason why these great forces should not be understood, at least as to their organization, purposes, and the services they are actually performing. Hence the method of selecting and treating in detail the larger features of social organization must be pursued in the more advanced work.

In conclusion, a glance at the topics suggested in the above illustration will re-inforce the thought expressed in the first paragraph of this article; viz., that the commoner sociologic and economic ideas, such as the division of labor, specialization of function, and the interrelation of social and economic parts, competition, coöperation, capital, labor, and the like, may be implicitly prospective in the subject matter, tho for some time not consciously expressed in the work of instruction. A good foundation for any one of the foregoing ideas can be laid by the careful objective study of the town, and its organic parts, above cited.

THE RAISON D'ETRE IN GEOGRAPHY

BY F. B. PEARSON, COLUMBUS, OHIO

The evident progress which has been made in the teaching of geography in the last decade is due, in large measure, to the fact that teachers have come to realize that the mind, even of a child, delights in tracing the causes of things, whether in history, in science, or in nature. There is no child but derives pleasure from the discovery that nature is not capricious, but that within her realms there is the same distinct sequence of cause and effect as in the domain of any other science. This discovery opens up to the child's mind an ever-widening field for investigation, and the working out of the logical results of this discovery tends to elevate geography to a position and to a degree of importance coördinate with other sciences. True, it overlaps other sciences or is overlapped by them, but the sum of all sciences is Science. Hence it is that teachers and learners now refer to the science of geography with assurance; and their study of the subject as a science, or better, perhaps, the study of the subject in a scientific way, is proving a boon to civilization. If this statement were in need of proof, it would be necessary only to mention the benefits of the signal service which reaches out a helping hand to all classes of society. It has taken cognizance of the fact that all business is affected, to a greater or lesser degree, by weather; and it gives such timely warning as enables business interests to make provisions for possible contingencies arising from changes of weather. This service is but one phase or manifestation of the scientific method of study in geography, but it serves to illustrate the possibilities of this method of study; and the great interest shown, even by children, in the subject of weather, is competent if not conclusive evidence that the scientific or philosophical side of geography appeals to children no less than to their superiors in age.

It is aside from the purpose of this article to exploit any new theories or to cite new illustrations; and the writer will be quite content if by re-iterating and re-inforcing, if possible, what has already been said, perhaps very often, he can emphasize the value of this method of teaching to the end that it may redound to the advantage of the learner as well as to the advancement of the scientific teaching of the subject. Starting with a single statement that in the city of Iquique not a spear of grass grows but by artificial means, we have instituted an investigation of causes which will prove far-reaching in its ramifications; for it is nothing less than an inquiry into the causes that have resulted in the desert of Atacama, that inhospitable region stretching two thousand miles along the coast of South America. Its presence there is not fortuitous, and hence we are recreant to our opportunities if we fail of an effort to induce the learner to compass the causes of its existence, and the facts that determine its limits. He soon discovers the eastern boundary in the Andes, and finds that the eastern slope of the mountains is favored with abundant rainfall as revealed by the presence of rivers. This brings him to a study of the influence of mountains on precipitation, begets an inquiry as to the direction of the air currents on that side of the mountain, and soon broadens out into an investigation of the whole subject of the circulation of the air, the effect of the equatorial heat, the rising of the air and its flowing off toward the poles, the movement of the under currents to take its place, and the influence of the rotundity and rotation of the earth in deflecting these currents from northerly and southerly directions. In the course of his study he discovers the gradual sinking of the upper currents in their course toward the poles, and is interested in the apparent coincidence of copious rainfall on the coasts of Norway and southern Chile at the same latitude, north and south. When he has localized the impact of this sinking air current upon the Andes, he has located the inevitable southern limit of Atacama. Incidentally, he has learned many facts connected with air currents, and has increased his vocabulary materially but only incidentally; for his inquiry has to do with this desert, and, no matter how circuitous the course, he must realize that this desert is his ultimate destination, the goal of his investigations. Desultory meandering is not scientific, and hence cannot be conducive to the highest good of the learner. Starting from Atacama, we must return to our starting point and so close up and complete the circle. To traverse this circle is to gain a fairly comprehensive and accurate knowledge of the principles of meteorology; and some such method of inductive study with a concrete fact to furnish initial momentum, cannot fail, under skillful, scholarly direction, of interesting the learner and of widening his geographical horizon at each successive step.

From such a vantage ground as the study of this desert affords, we can discern the causes underlying other desert regions with comparative ease, dwelling only upon dissimilarities in conditions. In the Sahara we shall meet the fact that the days are hot and the nights are cold, and must turn aside for a little to solve this related problem; for it may furnish a basis for some generalization. The accepted tenets of pedagogy may counsel us to seek the friendly aid of another concrete fact as our coigne of vantage; and, if we so, we can cite the fact that in mid-summer an iron pillar is cold if shielded from the sun's rays, and very hot if exposed to the sun. Such an illustration has the advantage of being neither conventional nor dogmatic, since it appeals to the learner's experience. Moreover, it may be made to serve a useful purpose in introducing easily and naturally the subject of radiation, including the affinity of heat and moisture.

Pursuing the line of reason thus suggested, we soon arrive at the explanation of the cold nights in the Sahara, seeing that its aridity precludes the absorption of heat to temper the atmosphere after night-fall. But, as before, many incidental facts have been learned in the course of our investigations, and we have crossed and re-crossed our own lines of reasoning many times, it may be. This, it may be observed, is a valuable feature of the method we are pursuing since these junctions become the foci of our reasoning, and furnish the data by which we may test the accuracy of our conclusions. These data established, we may call the imagination of the learner into requisition, and take long journeys over seas, mountains and deserts, and be able to determine with tolerable accuracy the character of the flora and fauna, and even the occupations of man as we proceed, and thus make geography one of the most entrancing of all studies.

Objection may be urged that our illustrations have to do only with physical geography; but the observation seems pertinent that there is no really valuable study of geography that ignores or passes lightly over physical features. Now and then we may have a city located by caprice or by the fiat of an emperor, as Berlin; but these exceptions only emphasize the rule that nature locates cities, establishes industries, and determines the occupations of men, thus moulding in large measure, their character. Whether we seek the determining causes of deserts, of the direction of our snowstorms, of the linen industry of Ireland, the manufacture of cotton in western England, the fishing industry off Newfoundland, the location of cities, or the production of corn, wheat or coal, we must enter the domain of physical environment, else the results of our efforts will prove abortive. So common an object as a loaf of bread affords the basis for an investigation that will ultimately include mountain-building, erosion, and the evolution of valleys, and also the physical conditions that restrict the wheat-growing districts to well-defined latitudes and altitudes. But certainly maturity of mind is not a condition precedent to an understanding of these facts. Our excursions may often lead us back to primitive civilization, when the fertility of the soil induced settlements, or when considerations of safety and convenience dictated the location of embryo cities at the lowest fords of rivers. In whatever direction our paths lead, we are confronted with physical conditions, nor can we with impunity disregard them. It may happen, also, that in our search for primal causes we shall be brought up sharply at the utmost boundaries of human knowledge, but even this should not place a ban upon such investigations. This will certainly happen if we are delving into the secrets of the Atlantic sea-board, or of the upper Mississippi valley where we shall encounter the glacial epoch; but how poor would be our teaching of the geography of these regions if the glacial epoch should be eliminated.

Without further exemplification of this plan of teaching, or of the fundamental influence of physical conditions, it may be added that there is a rapidly growing sentiment among progressive teachers in favor of some such plan as has been suggested, because it arouses interest, develops the imagination, strengthens the observational and reasoning powers, and inculcates and fosters correct mental habits.

EXPERIENCES IN FIELD WORK

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The geography of the not far distant past has been almost wholly descriptive. It has consisted of mechanical definitions of land forms and bodies of water, which gave but little idea of the forms defined and none of their origin.

Countries and states were bounded, their capitals and principal towns named and located, and their products enumerated. A volcano was a "burning mountain"; and rivers rose in lakes and "emptied" into the sea. We did not learn why the volcano ejects lava and broken fragments of rock, which are wrongly called "ashes", or that it does not really "burn"; nor why the Delaware, the Susquehanna, and the Potomac rivers cross the Alleghany and Blue Ridge mountains to reach the Atlantic, while New river crosses both the Alleghany and the Blue Ridge in the opposite direction to reach Ohio.

We learned that Albany, Trenton, Richmond, Raleigh, Columbia, and Atlanta were state capitals; but their relations to tidewater, coastal plain and interior basin were left for more recent times to discover. In this way one continent after another was studied, and the artificial, stereotyped classification applied to all. Fortunately for the pupils of the present day, the old method is a thing of the past, and a rational method has come to take its place.

To two fundamental ideas is due the welcome change. *The law of cause and effect* has now come to be recognized as the guiding principle in geography as in the other sciences, and under the name of "the causal notion in geography" has come to dominate our modern teaching. The second notion is that of *the type form* by which the features of the earth's surface are described with relation to the *forces* which operated to produce and to give to each the characteristic structure and form which the great physiographic processes everywhere bring forth. Now that these ideas have come to us, teachers are seeking on every hand for means to advance and develop them.

I believe that the new era has only just begun and that we are entering upon a period of wonderful progress in this science. Certainly more attention is being given to it; and its claims for more time in the curriculum and for special preparation on the part of teachers is being recognized. Full recognition cannot come too soon. Field work in geography is but one step in the development of the causal notion. We are looking for the *forces* which have produced and are producing the type forms. To understand how these forces produce the type forms we must *see them at work.* We cannot see this in a book. We must go out-of-doors.

As soon as the necessity for such work is recognized, teachers begin to ask, "How shall we go about it?" "Where shall we go?" "What things shall we study?" and "What shall we do with what we have learned, after we return to the class-room?"

I shall not attempt to enumerate all the things that may be studied, but will describe a few experiences with my own classes in the field, and tell what we did with the material which we obtained. We had learned in school that there are three great physiographic processes by which the surface of the earth has been fashioned, and that those same processes are now in operation to produce still further changes in its contour. These processes are *diastrophism,* by which the crust of the earth is elevated and depressed; *vulcanism,* by which melted rock is poured out upon the surface and forced between the strata; and *gradation,* by which the surface of the land is being planed down and the waste carried to the sea.

We could not study diastrophism in the field, because it is too difficult a subject and its effects cover too broad an area. We could not study vulcanism out-of-doors, because our school is not located in a volcanic region.

But we could study gradation, because its effects are the most widely distributed of those of the three great processes, and because our school is favorably located in one of the great drainage basins of North America. More than this, the gradational process is always actually at work at the present time and always will be. The final object of the series of lessons was to enable us to understand the geography of our home city, and to know the reasons why it has come to be the metropolis of one of the most populous states of the Union.

We went to the gorge of Euclid creek, ten miles east of the public square in Cleveland, to study the gorge and the flood-plain of that stream. It may be asked why it was necessary to go so far away to get information, when we have a river flowing thru the city, with a larger volume of water, a wider valley, and a more extensive flood-plain. The reasons are two. First, the river at Cleveland lies in a densely settled district covered with many buildings and difficult of access by a large class. Second, the very fact of size and many complications due to modifications and improvements made it more desirable to go out into the country, where we could find a small stream with all its features nearly in their original condition, but little modified by human agencies.

At Euclid avenue, the stream emerges from a gorge about one hundred feet deep, and flows northward, meandering across the former bed of Lake Erie to the present shore line.

We turned our attention on this excursion to the part of the stream south of the avenue, where it has dissected the plateau which was formerly the plain bordering the lake.

We followed the stream and were soon within the gorge, standing upon the surface of a flood-plain a quarter of a mile wide into which the stream had cut a trench about ten feet deep. First we gave our attention to the stream. It contained but little water at this time, altho we could see that it contained more in times of high water. Its bed was the horizontal shale rock, and upon this were scattered boulders which had been washed out from the drift and brought along by the stream. Its banks were steep and overhanging where the curve of the stream threw the water against them; while the opposite banks were low and shelved toward the water where tongues of new-made land had been deposited in the quieter eddies.

The stream was at work; and by setting sticks afloat we quickly saw the course of the water as it set now toward one bank, now toward the opposite one, in the smaller curves. This led us to observe the wider sweeps from side to side of the entire valley. About midway of the length of the gorge, it crossed completely from the base of one bluff to that of the other, with intervening smaller meanders. Upon the peninsulas thus formed were patches of vineyard, which showed us the agricultural value of the alluvial soil of the flood-plain.

Where the stream touched the base of either bluff, there was a sheer ascent of the full height of the valley wall. The stratified shales had been cut as with a knife; and so far had weathering progressed, that two active boys ascended half way to the top by digging their heels into the soft material. From the face of the opposite bluff we obtained some fine photographs of the rain gullies upon its surface; and afterward a lantern slide was made for use in the school room. This work was done by a pupil. Continuing our journey, we ascended to the topmost level of the valley wall, by a road which was cut into the bluff. On one side of this road was a steep wooded slope to the stream, while on the other was the steep wall of shale, decreasing in height as we ascended.

No figures could have given us the idea of the depth of the gorge which we got from the experience of climbing; and the pupils had but to reach out and handle the disintegrated shale and dig away the loosened fragments to the firm rock beneath, to see thru what the stream had cut its way, and how the valley is still being widened by weathering. Finally we reached the top and came out upon a plateau which stretched away with a slight rise to the upland far away against the southern horizon, where the sky-line was unbroken as far as the eye could see. Facing northward, we saw the stream far below, meandering across its flood-plain within the gorge and out across the plain beyond to the blue line of the lake on the northern horizon. Then, and only then, could we appreciate the enormous quantity of material which even this little creek, insignificant in the great St. Lawrence system of drainage, had done.

The aneroid barometer had been set to zero at Euclid avenue; and now we read it to see how deep the gorge was. This was the occasion of a lesson on the aneroid barometer and the method by which we obtained the result.

We returned thru the valley again to the street cars at the avenue, and reviewed what we had seen in the light of the completed work. This excursion was made on a Saturday afternoon; the cost to those who went by street cars was twenty cents, and to those who went on bicycles, nothing. All were at home before six o'clock.

This lesson on stream erosion was followed by two on the work of waves, along the shores of Lake Erie. We went first to Glenwood beach, east of the city. Here there is a continuous beach one hundred feet wide and several miles long, including Glenwood, Villa, and Euclid beaches, back of which rises a bluff of clay and sand to a height of forty feet.

First we noted the direction of the wind which was from the west, the prevailing direction along the lake, and also the angle at which the waves met the shore, about forty-five degrees. Approaching close to the water's edge, we observed the zigzag course of the pebbles which were being moved along by the waves; and bits of wood were thrown in and traced for several rods down the beach. This gave us the general direction in which the lake moves the waste along the shore.

As far as we could see out under the shallow water were great beds of ripple marks in the sand. These we studied carefully by cutting them thru with a stick and watching the waves fill the gaps again. The pupils had already noticed the ripple marks in the many stone sidewalks of the city; now the origin of those marks was understood. Back a few feet from the water was the well marked crest-line of the beach, sloping sharply toward the lake and more gently toward the base of the cliff. All the time we were walking along this ridge, studying its mode of formation and its direction parallel to the shore. Finally we walked close to the edge of the bluff. Here driftwood had been heaped by storms; and beneath the overhanging wall were many sea-caves. A storm of that very week had brought down great masses of clay large enough to fill a wagon, and some of the boys climbed to the top of the bluff and dislodged more.

Then we could see how the shores of the lake are retreating, and how the owners of land there must protect their property from the attacks of the waves by building sea-walls of stone or buttresses of wooden piles.

On a following Saturday we went to Edgewater park, west of the city, and again studied the work of the waves there. The beach was similar, so that we could review the preceding lesson by seeing the same forces at work at another point. At the extreme western end of the park, however, the beach ends abruptly against cliffs of shale which rise perpendicularly from the water. No finer example of a sea-cliff could be found along the lakes. We were able to go along its base for a short distance by walking upon a narrow rock shelf, and a still lower shelf could be seen projecting out beneath the water. Sea-caves were abundant; and lying in them were heaps of rock fragments, the tools which the waves had used to hollow them out.

Here we used the clinometer, to see the slight eastward dip of the strata of shale; and the aneroid barometer gave us the height of the cliff. We also examined the thin layer of glacial drift overlying the shale, and found drift boulders mixed with the fragments of native rock in the pebble beach. About midway of the sand beach the shales disappeared, because they had been cut away by the pre-glacial Cuyahoga, and the old valley had been filled with the delta sand.

Each of these excursions to the lake was attended by about one hundred pupils, the cost was inappreciable, and each occupied but a Saturday afternoon.

Now what could we do with the material so obtained, after we returned to the class-room?

I will describe briefly the geographical features of Cleveland which were brought to their attention, and which they were prepared to understand: tho I may say that we did not depend solely upon information gained by the excursions described. It was taken for granted that the pupils were familiar with the general topography of the city, thru daily experience; and that it would be necessary only to name well-known streets and localities within the city proper to call to mind their general character and formation.

Most of the city lies upon the delta of the Cuyahoga, which was built early in post-glacial time, the West Side and the "Heights", however, lying beyond the limits of the delta. Beneath the delta sand lies the Erie clay, which fills the pre-glacial valley of the Cuyahoga to a depth of three hundred feet.

The pupils had seen the delta sand, with the clay beneath it, on both excursions to the lake, and the shales at Euclid creek and west of Edgewater park. To reach the "Heights", where all had been many times, it is necessary to ascend the eastern wall of the old valley, by roads which are cut in the shales.

As in all deltas, the sides converge up stream, and in this case to the southward, while the third side runs parallel to the lake. In addition, there are several lake terraces along the northward margin of the delta, and some of them are so far back upon the delta that their ends meet the diverging walls of the pre-glacial valley.

Euclid avenue runs lengthwise of one of these terraces; and to descend to Superior street, by passing thru the Arcade, in the business portion of the city, one must go down over the old beach by a flight of steps. Many streets running northward from Euclid descend successive terraces; while a trip to Painsville by the trolley cars carries one for miles in sight of others running parallel to the track, and but a quarter or half mile away.

With all these features in mind, then, it was possible for us to give an account of the successive cycles thru which this region has passed, and to understand how the present topography has been developed. Starting with the St. Lawrence of pre-glacial time, we saw in imagination that great river flowing in a diastrophic rock valley to the sea. The great lakes were but expansions of the river, where wider and deeper portions of the valley collected the waters until they rose to overflow into the lower reaches of the stream. Tributaries entered the great river, and among them was the Cuyahoga also in a rock valley. Degradation continued and the Cuyahoga deepened its trench by cutting vertically downward thru the shales, while the valley was widened by weathering, just as we saw the valley of Euclid being widened at the present time. The height of the rocky wall which bounded the lake on the south was no doubt so great that the river fell over an escarpment and made a cataract near its mouth, because we now find a considerable waterfall farther up the present stream, at Cuyahoga falls. We argue, therefore, that the falls retreated upstream, just as we know Niagara falls to have done. This first cycle was not completed, and the course of the Cuyahoga was not completely graded, because a diastrophic movement interrupted it by depressing the land below the level of the lake. What the cause of depression was, further than that it was due to the general agency of diastrophism, we could not say; but undoubtedly the enormous weight of the ice of the glacial period which immediately followed, assisted the downward movement of the rocks beneath. The old rock valley of the river was filled with glacial clay to a depth of three hundred feet, and over this the river again found its way to the lake.

Instead, however, of excavating a deep gorge in the clay, as it did in the shales, it cut only a shallow trench; and where it entered the lake it deposited its burden of waste by building a delta. The material of the delta had been washed out from the glacial drift which the ice sheet had left along its upper course.

During this second cycle, the site of the present city was underneath the waters of the lake, because the depression of the land and the backing up of the waters of the lake by ice dams carried the shore line back several miles from the present shore line and from the mouth of the old rock valley of the river.

The series of old lake beaches marks the retreats in the recession of the lake waters, when the ice dams melted away and allowed them to resume their former course to the sea. As these retreats succeeded one another, more and more of the delta emerged from the water, and the land surface was increased by additions on the lakeward edge. During the same time, the Cuyahoga had its exit to the lake carried farther and farther down stream, and it lengthened its course by cutting thru the delta as fast as successive strips were added.

The river has remained a meandering stream, with many sinuous curves, because the additions of glacial clay and delta sand have raised its base level nearly to the height of its present bed; and the grade of the stream is very slight from Cuyahoga falls to the lake. From that point it is typical of the mature stage in stream development, and the third cycle may be considered to be near its end. It would certainly be interesting to know what the nature of the forces will be which will interrupt this cycle and set the Cuyahoga of the future upon another stage of its history.

What could be more inspiring than to stand upon Euclid Heights, near that landmark of American political history, the Garfield Memorial, and, looking out across the great city beneath toward the setting sun on the far horizon, to contemplate the geographical history which has been wrought in the valley before us?

It is easy to climb the snow-clad peaks of the Alps or to traverse the cañons of the Rocky mountains, and there feel the exhilaration which comes to one when he stands in the presence of those mighty works of Nature's forces, but only a few of us can go so far from home to be inspired.

How much more profitable it is to know our home region in such a way that we have only to go outside the walls of our schoolrooms to see how the great physiographic processes have given to the lands their familiar form and outline.

When we can do this, then we shall be prepared to see other regions in their relations to their origin and development. New interest will be aroused in proportion as we gain power to interpret their forms, and when we again go abroad in our own country and in others, we shall look with eyes newly opened and minds alert to know the wonders and beauties of this earth of ours.

A LESSON PLAN ON CORK

BY MARIA W. BISHOP, STATE NORMAL SCHOOL, CORTLAND, N. Y.

Aim of Lesson. To give information about one of the most useful articles of commerce, and to cultivate imagination, reasoning and memory.

Note. Lesson may be given in connection with Geography or as a basis for Language work.

Material Used. Corks, bottle of water, piece of sponge, cork sole, piece of linoleum, and any manufactured articles made from cork.

Introduction. Show corks to arouse interest and direct attention. The invention of vessels with small necks made corks as stoppers valuable. Greek, Roman and other antique vessels had none.

Presentation.

MATTER	METHOD
1. Cork—part of the rough outer bark of a kind of oak called cork-oak.	1. Teacher show specimen, obtained from some factory. Compare with piece of bark from any common tree.
2. Cork-oak tree (*Quercus Suber.*)	2.
1.) Height, about thirty feet.	1.) Make height concrete
2.) Diameter, six inches to three feet. Much smaller than our oaks.	2.) by comparing with some known tree.
3.) Appearance, evergreen.	3.) Are our oaks evergreen? Why not?
4.) Home: Spain (chiefly), Portugal, Algeria, Morocco.	4.) Show map and locate countries. What is the climate?

5.) Care of the trees. The cork-oak groves require no special care other than clearing away underbrush as a precaution against fire.	5.) Teacher tell class.
6.) Length of life, 150 years and sometimes even more.	6.) Teacher tell class.
3. The bark (cork-wood.)	3.
1.) Time of removing: June, July. June is the best month.	1.) Why is June best? It is an almost rainless month in southern Spain, and bark is most easily removed then.
2.) Method of removing: A cut with axe or hatchet is made around the trunk near the ground, and similar cuts below the branches. Vertical incisions are then made and the pieces of bark are pried off, care being taken not to injure the inner bark. If this were injured the tree would die. The main branches are stripped in same manner. The tree soon turns copper color after removal of bark.	2.) Show pictures. Make simple drawings or illustrate with stick or pointer.
3.) Age of tree when first stripped: About twenty years.	3.) Teacher tell class.
4.) Frequency of strippings: About every eight or ten years.	4.) Teacher tell class.
5.) Yield per tree: Fifty to five hundred pounds.	5.) Teacher tell class.
6.) Quality of bark depends on soil, season, location and age of tree. The first bark taken from the tree ("virgin" bark) is coarse and	6.) Compare effects of similar conditions at home.

woody in texture, but it improves in quality with each successive stripping. The same tree may, at different times, yield widely different qualities of cork-wood. A slow-growing layer of bark is of finer quality than one of rapid growth.	
4. Preparation of cork-wood for transportation to factories.	4.
1.) Drying: Sap is driven out of the bark by drying in sun and air for several weeks.	1.) Question on what children would expect to find in bark and how it could be dried.
2.) Boiling: This is the next process and permits the sheets of cork to be flattened under heavy weights while under water, and gives softness to the cork.	2.) What must be the shape of a sheet of cork when cut from the tree? Would these pieces pack as easily as if flat? Etc.
3.) Scraping next removes some of the woody bark and lessens its weight.	3.) Would rough outside of bark be of any use? How could it be removed?
5. Transportation from the forest to the factory or nearest shipping point.	5.
1.) By wagon when roads permit.	1.) Question on probable methods of transportation.
2.) On backs of donkeys. They are driven in trains and are in charge of muleteers (*"arrieros."*)	2.) Describe procession of donkeys in the narrow Moorish streets, the huge bales of cork almost hiding the patient beasts, and nearly filling the width of the street.
6. Re-shipment: At the Seville factory the bales are opened, sorted, and the bark classified into several qualities and thicknesses, after which	6. Teacher tell class.

it is re-baled for shipment to the United States and other countries.	
7. Cutting and shaping cork stoppers: In parts of Spain corks are still cut by hand, a slow process, and are of an inferior grade. When shaped by machinery, the cork is first cut into strips of the right thickness by a circular saw having a razor edge instead of teeth, and turning with great speed. This cuts a cylindrical cork. The tapering corks are made by another machine which shaves them to the required size. The shavings are all used for various manufactured articles.	7. Teacher tell class.
8. Uses of cork-wood.	8. Uses developed by questioning and experiment. Uses depend on qualities.
1.) Corks for stoppers and bungs. Shapes, flat, tapering, cylindrical. Corks not used for stoppers until near the end of the seventeenth century.	1.) Use piece of sponge as stopper in bottle of water. Tip bottle. Why is not sponge good for the purpose? Why is cork good? (Elastic, compressible, not porous. Pores have been closed.) Speak of uses of the different shaped corks.
2.) In-soles for boots and shoes.	2.) Show cork in-sole. What quality makes it useful for this purpose?
3.) Linoleum.	3.) Show specimen. Of what made? Use?
4.) Life-preservers.	4.) Float a cork in water. Place coins or weights on it.

5.) Seine floats.
6.) Washers.
7.) Bicycle grips.
8.) Linings for hats and helmets.
9.) Artificial limbs.
10.) Bath-room floors and wainscoting.
11.) For packing eggs.
12.) Filling for mattresses.
13.) Covering for pipes, etc.

Infer its use as life-preserver.

5. to 13.) Bring out by question and simple experiment the connection between qualities and uses.
To show that cork is tough try to cut it.
To show its smoothness and dryness touch it, etc.

Note. Notice value and variety of the by-products. The smallest shavings are utilized. Over five thousand different sizes and varieties of corks and cork-products are turned out of the factories.

ASSOCIATION. Compare value of bark of cork-oak with India-rubber or *caout-chouc,* and Peruvian bark from which quinine is obtained. It is impossible to estimate the commercial value of these three trees. Compare with usefulness of precious stones mined.

GENERALIZATION. Cork is one of the most useful and has become one of the most necessary of our manufactured products. For some of its uses there seems to be nothing that would take its place.

APPLICATION.

1. Higher regard for trees and greater interest in them.
2. Notice ingenuity shown in using by-products.
3. Alertness to discover all possible uses of cork.
4. Use the story of the cork for language work.

A SERIES OF LESSONS LEADING TO LAPLACE'S NEBULAR HYPOTHESIS

(Continued from Vol. I, page 365)

BY THEDA GILDEMEISTER, WINONA, MINN.

LESSON III. ADHESION AND CAPILLARY ATTRACTION

AIM: To show the value of the molecular force, *adhesion*, and its related form of attraction called *capillary attraction*.

PREPARATION:

1. *Materials.* The teacher has ready some clay, moist earth, sand, crayon, blackboard, cloth, paper, pencils, blotter, ink, and whatever else is needed in the presentation.

2. *Children's Minds.* What forms of attraction have we already studied? How far away from the attracting body were the substances attracted? (Usually far apart, but in some cases we had to lay the magnet *against* the object before any attraction was visible.) Did that prove there was no attraction? (No. Because the magnet would hold the pen, and the amber the paper, when once laid together.)

PRESENTATION:

1. If I should lay or even press these two objects (teacher selects any two) together, what, do you think, would occur? Let us find out. John may make a sphere from his clay. Willie may model a hill in this sand. Lulu may put some of this mud on the paper, and Ellen put some on the cloth. Fred may lay, or even press, this crayon against the blackboard. Teacher may quietly lay a thread or a hair on the dress of one of the girls.

You have all finished your tasks. Let us talk of what you have done. Show us your sphere, John. Did you put *all* of the clay into it? Every particle? Why not? What made that adhere to your hands? (I don't know.) You will soon see why. Look at Willie's hill. Has he put all of the sand I gave him into the hill? How may we tell? Yes, let us see your hands, Willie. (Perhaps Willie says: "I wiped them on my trousers; there *was* sand on them.") That certainly isn't the best thing for the trousers, but let us see whether there is any sand there. Yes, here it is, adhering to the cloth. (Notice that teacher uses "adhere" as often as possible, but for the present makes no remarks about it.) What is that adhering to Mary's dress?

When you think of our former lessons, and then of what has just been seen, can you tell what causes these substances to *adhere*, or *stick together?* (It must be some form of attraction.) It *is* a form of attraction, called *adhesion.* (Teacher writes word on board and compares it with "adheres.")

Let us now think of all the substances which we have thus far found adhering, and decide just what sort of force this adhesion is. (Teacher, by questioning, leads children to see that adhesion is a form of attraction existing between different substances, when in contact. She explains too that it is an attraction of the small particles of each substance for those of the other, and as these small particles are called *molecules*, the force is a *molecular force*).

Let us now think of other instances of adhesion.

2. Children will probably name water on cloth, ink on blotter, or some other example of capillary attraction, thus giving the teacher the opportunity to explain that this *is* adhesion, but as it is a special form of it, we give it a special name. The children have probably had some physiology and know what capillaries are. Call attention too to the value of capillary attraction in the life of plants.

ASSOCIATION AND COMPARISON:

1. Compare *adhere* with *adhesion.* Associate the two terms with each other and with their meanings.

2. Contrast magnetism and static electricity with our new form of attraction.

   a. The former forces act between *masses.*
   b. The latter force acts between *molecules.*
   c. The former act at greater distances than does the latter.
   d. Compare the advantages of adhesion with its disadvantages.

(1.) Advantages: People can build homes, make furniture, prepare food and clothing, print and make books, manufacture small useful articles, write letters, as well as do a hundred other things.

(2.) Disadvantages: People find dirt and dust adhering to their faces, hands, and clothing.

GENERALIZATIONS:

1. Adhesion is a form of attraction.
2. It is a molecular force.
3. It acts between molecules of different substances when they are placed together.
4. Adhesion is a very valuable force to man.
5. Capillary attraction is a special form of adhesion. It, too, is useful to man and to all nature.

APPLICATION:

1. Make as complete a list as possible, showing examples of adhesion and capillary attraction. Suggestive list:

a. Dirt on paper, apron, collar, hands, face, window, paint, etc.
b. Crayon on blackboard, paper, floor, desk, fence, etc.
c. Pencil marks on paper, cloth, wood, etc.
d. Ink marks on paper, cloth, desk, blotter, etc.
e. Mucilage or glue on wood, paper, etc.
f. Plaster, paint, varnish, and paper on the walls of a room.
g. Water spilled on table, or water adhering to side of glass, or to pencil or piece of wood inserted into a bottle of water, etc.
h. Water and sugar, or salt, etc., in solution.
i. Hair, shaving, chip of wood, thistle down, etc., on clothing.
j. Ink on outside of bottle. On pen. On page of book.
k. Syrup, grease, etc., on apron (when cooking).
l. Cooked syrup and popped corn to make pop-corn balls.
m. Butter, etc., on bread. Frosting on cake.
n. Graphite and wood in "lead" pencils.
o. Water and soil to make mud.
p. Sulphur on end of match.
q. Pins in cushion. Nails in house.
r. Water in cloth. (Dry your face or hands.)

2. Make a list of all the things about *houses* showing adhesion, e. g.,
   - *a.* Nails and wood.
   - *b.* Mortar and brick.
   - *c.* Plaster and laths.
   - *d.* Varnish and wood. Etc.
3. Make a list of all things *within* a house, showing adhesion.
4. Make a list of toys depending upon adhesion.
5. Ditto manufactured articles.
6. Ditto kitchen utensils.

LESSON IV. COHESION

It has seemed best to divide this into sub-lessons, as, under this topic, several distinct aims may be given. As before, each lesson, or sub-lesson, may cover more than one recitation period, if necessary.

SUB-LESSON A

Aim: To teach children a second form of molecular attraction—*cohesion*—, and its uses.

Preparation:

1. *Materials.* Crayon, pencil, wood, pasteboard, iron, steel, glass, brick, coal, rock, paper, blotter, cloth, etc.

Children's Minds. Briefly review the previous work, emphasizing these points: *a.* We have learned of two sorts of forces, *molar* and *molecular*. *b.* We found adhesion to be a molecular force, a form of attraction acting between molecules of different substances brought close together.

Now let us see whether there is any attraction between the molecules of one substance.

Presentation:

Give each child one of the substances prepared, saying that each must try to find out whether his substance exhibits any signs of attraction. (Some bright child will be sure to say that if there were *not* any attraction between the molecules, the substance would crumble, or disappear. If not, teacher must ask leading questions to bring this out.)

Teacher now breaks a piece of crayon, a piece of stick, or lets a piece of glass fall and break. What do you now think of the attraction between the molecules of the crayon, glass, and stick? Does this prove there is no attraction? Have any of our other experiments helped us in reaching this conclusion? (In magnetism, e. g., we could detach the pen or needle from the magnet, but this did not prove that there was no magnetism.) Give other examples of this sort. Then, because I can overcome the attraction between two bodies, shall I say there is no attraction?

Returning to our study of the substances, Dorothy, what can you say of the wood in your pencil? (There must be some attraction between the molecules, or it would fall apart. It wouldn't *be* a pencil, at all.)

Can we *see* the action of the attraction? Why not? (It is between such small particles and these particles have to be so close together.) This form of attraction is called *cohesion.* (Write word on board and bring out meaning, as suggested under association and comparison.) Each of you may now name five substances exhibiting cohesion.

Association and Comparison:

1. Compare *cohesion* with *adhesion*,
    a. As to spelling.
    b. As to meaning.

2. Compare prefixes of *cohesion* and *adhesion* with others studied in language class.

a. co-adjutant,
co-agulate,
co-efficient,
co-equal,
co-existent,
co-extension, etc.

b. ad-dition,
ad-dress,
ad-jacent,
ad-jective,
ad-join, etc.

Generalizations:

1. Cohesion is a molecular force, a form of attraction existing between all molecules of the same substance.

2. Cohesion is an invaluable force in nature. Without it we could not have clothes to wear, food to eat, dishes to use, books to read, etc.

Applications:

Name all possible substances in this room which show the existence of cohesion.

SUB-LESSON B

Aim: To discover the relative strength of cohesion in various substances, thus classifying them into (*a*) solids, (*b*) liquids, (*c*) gases.

Preparation:

1. *Materials.* Same as for lesson A, with the addition of some liquids, and some sort of heating apparatus, either gas-jet, alcohol lamp, or a kerosene lamp, with some crossed wires on the top of the chimney, to hold the cup.

2. *Children's Minds.* Brief review and general statement of the aim; viz., Today we are going to see whether cohesion is stronger in some substances than in others.

Presentation:

1. From the table each of you may select some substance in which you are sure cohesion is acting.

2. Let us now try different ways of overcoming the cohesion. *a.* All rub your substances on your hands; on some paper. *b.* All try to break your substances. *c.* Some of you may use these mortars and pound your substances. *d.* Blow your substances away, if possible. *e.* Helen may hold her piece of sealing-wax over this candle flame. *f.* Hugh may put his lump of sugar into this glass of water and watch it.

3. Does water show the action of cohesion? Let us try some of the above experiments upon it. Can you break it? Pound it? Blow it away as you did the flour? Stir the water in this glass. Pour some into that oddly shaped tube. Do the molecules still cling together? (Yes.) Pour out some of your glass rod, Alice. Why do you laugh? Helen may pour out some of her bar of sealing-wax. Can she do anything to it so she *could* pour it out? Can water be changed so that it will *not* pour out?

Name other substances in which the molecules move easily from one place to another.

4. Let us put this cup of water over the lamp and see what occurs. What is happening to the water? (Heat is changing it to vapor.) Where is the vapor? Can we see it? Do the molecules of this vapor separate easily? More easily than before? Do you think the cohesion very strong in vapor? In which form of water was it strongest?

5. I am sure you know what we call such substances as ice, starch, indigo, glass, and leather. Yes, they are *solids*, because the cohesion is strong enough to prevent the molecules from moving at all easily. Of course some solids have more cohesive strength than have others, but we shall not classify them now.

6. And substances in which the cohesion is not so strong but that it allows the molecules to move quite freely, we call ———? Yes, *liquids*. Name the most common liquid. Name others besides water.

7. Heat did what to the water? Did the molecules then move freely? Yes, very freely; so freely that it is with difficulty such substances are kept together. They are called *gases*.[1] Name some gases of which you learned in botany. In physiology.

ASSOCIATION AND COMPARISON:

Compare the three states of matter, one with another.

GENERALIZATIONS:

1. There are three forms of matter.
2. Many substances may be made into all three states.
3. A *solid* is that form of matter in which the molecules closely cohere.
4. A *liquid* is that form of matter in which the molecules move freely, yet tend to cling together.
5. A *gas* is that form of matter in which the molecules constantly tend to separate.

APPLICATIONS:

1. Classify into solids, liquids, and gases, all the substances on this table.
2. Carefully explain the three states of matter. Upon what does each depend?

SUB-LESSON C

AIM: *a*. To show how adhesion may overcome cohesion, or the reverse. *b*. To show how both adhesion and cohesion may be overcome by other forces.

PREPARATION:

1. *Materials*. Pieces of alum, indigo, starch, wood, glass, slate, quartz, charcoal, coal, iron, stone, brick, crayon, wire, paper,

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[1] If teacher wishes she may give the term "aeriform fluid."

pasteboard, bar sealing-wax, salt, and loaf sugar. Some water, milk, red ink, black ink, vinegar, molasses, mercury, and such other liquids as are convenient. Some spoons, glasses, a cup, and some sort of heating apparatus.

2. *Children's Minds.* Today we shall try to see what forces oppose cohesion and adhesion, and whether this is a wise provision for us.

PRESENTATION: I. Cohesion, how overcome.

1. Substances handled and named by pupils. What force is now acting? (Cohesion.) Can anything overcome this force? Try breaking, rubbing, pounding, blowing, and dropping the various substances, as in sub-lesson B.

Note changes and derive that *cohesion may be overcome by*

a. Friction,
  (1.) Shown in indigo, starch, crayon, charcoal, etc.
b. Muscular force
  (1.) Breaking,—stick, pencil, etc.
  (2.) Pounding,—alum, brick, etc.
  (3.) Blowing,—flour, dust, etc.
  (4.) Dropping,—glass, coal, etc.

2. Insert your pencil in this water. Look at the pencil. Describe. Put your finger or hand into this water. What is true of your hand? Put some of this sugar into one glass, some indigo, salt, etc., into other glasses. What has become of each? How can we know that each hasn't absolutely disappeared? Very well, we will taste the water into which we put the alum, sugar and salt. And, as you say, the color shows us the indigo is still present in its glass. What force acted in each of the above experiments? (Adhesion.) What of its strength? (It was stronger than cohesion, for the water clung to our fingers, to the pencil, and to the towel; and the sugar, salt, etc., were broken into fine particles by the water). Then we may add to our outline above,

c. Solution.

3. Let us now heat some of this water. Will the cohesion be overcome? What agent will produce it? Then we may add to our outline,

d. Heat.
  (1.) Changes liquids to vapor.
  (2.) Changes solids to liquids.

4. If teacher desires, she may show additional ways by using chemicals; but it seems better to leave this, with the statement that there *are* other ways, which the children will learn later. In the later study of gravity, one agent will be added. In geography, the teacher may show how the wind, rain, frost, etc., gradually overcome the cohesion in great rock masses, in clods of earth, etc.

5. Show by a few simple questions that all substances do not have the cohesion overcome in the same way. For example, rub the finger on wood, then on starch. Insert a dry finger in mercury, then in water. Try to pick up some of each.

II. Cohesion how strengthened.

By experiments show that cohesion is strengthened by,

a. Heat—as in evaporation of water from solutions. Salt, alum, sugar, etc., are left in a hard mass.

b. Cold—as in condensation of vapors, and in freezing of liquids.

[Note: From these lessons, the teacher may branch, lengthening the course, by fully discussing evaporation, condensation, crystallization, distillation, divisibility of matter (as shown by pounding and dissolving the sugar), mixtures, physical changes, chemical changes, and physical and chemical forces.]

III. Show how *adhesion* may be overcome by many of the same forces given under I. Illustrate each by examples all about us. We see the paint and varnish crack in our houses. Chairs come apart. Plastering falls. On frosty nights nails are heard to snap. A tin cup may have its handle loosened by heat melting the solder. Starch "settles" in glass of cold water, so does either sand or loam. Silt settles in a pond or river bed, etc.

ASSOCIATION AND COMPARISON:

1. Is nature wise to provide forces that overcome either adhesion or cohesion?

2. If cohesion were the most powerful force in nature, how would it affect us? Sugar would not dissolve in our coffee. Nails would not stay in wood. Mortar and bricks would not adhere, etc. Name all possible inconveniences. Name some conveniences which are greater.

3. Same for adhesion.

If we laid a book on the desk, or a plate on the table, or a knife on a plate, what would happen?

GENERALIZATIONS:

1. Adhesion and cohesion are opposing forces, and both are opposed by many other forces.
2. This opposition of forces is a wise provision.

APPLICATIONS:

1. Let children reproduce, by questions, or from statements, such parts of the presentation as the teacher desires well remembered.
2. Apply knowledge of the two forces by having children describe some series of actions, telling what force acts at each step. For example, washing the face with clear water.
   - *a.* Adhesion holds dirt to face.
   - *b.* Adhesion, in the form of a solution, takes dirt from face into water.
   - *c.* Capillary attraction acts in drying the face.
   - *d.* Evaporation takes place as the towel dries.

(To be Continued.)

THE FISHING INDUSTRY OF NEW ENGLAND

BY RALPH S. TARR, CORNELL UNIVERSITY, ITHACA, N. Y.

The coast of northern New England is the seat of the most extensive fishing industry of the country. The reasons for this importance are many and various. Of course first among the reasons is the fact that various kinds of sea food are abundant; but even this is due to causes. Rational geography consists of a study of cause and effect in respect to man and his doings; and this industry, one of man's doings, seems to me well adapted to illustrate the influence of surroundings upon man and his industries.

When the coast of New England was first settled the immediate coast-line abounded in sea food of various kinds. Cod, haddock, hake and halibut could be caught from the rocks; salmon periodically ascended the bays, estuaries and rivers to spawn; herring, menhaden, and mackerel frequently visited the coast in "schools"; lobsters crawled about in the shallow water and could even be found in the tide pools, left by the receding tides; and clams burrowed in great numbers in the sand and mud banks of the estuaries.

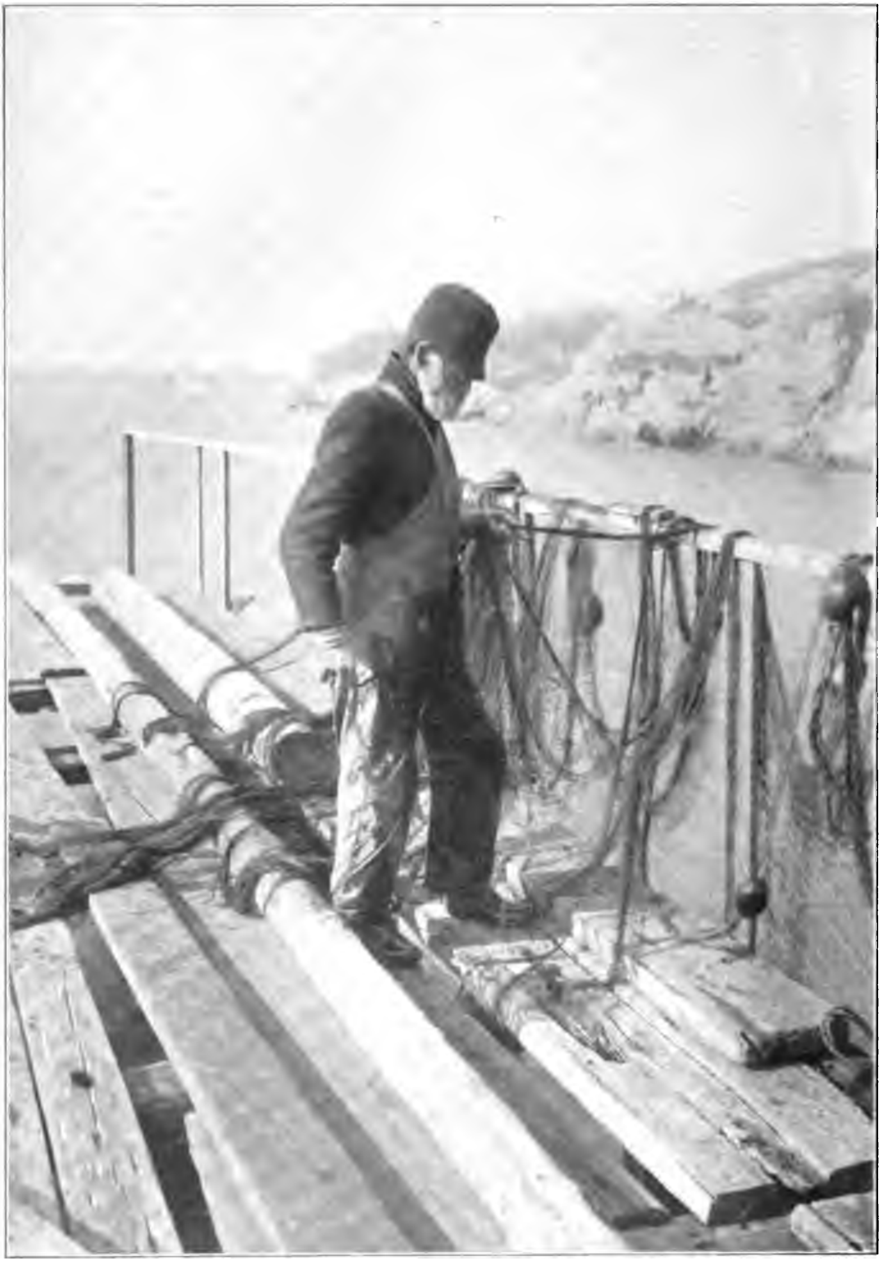
Most of the photographs in this article were made by Phelps, photographer, Gloucester, Mass.

The physiography of the New England coast is largely responsible for this abundance and variety of sea food. The land is hilly and made of hard rocks. As a result of land-sinking, in late geological time, the sea water has been made to cover some of the hills, and to enter the valleys, while the waves beat against the partly submerged hills which project as headlands into the sea. This land-sinking has made many harbors, great and small; in fact far more than the commerce of New England demands. It has also lengthened the coast-line by introducing these many irregularities, and this has increased the area in which shore-line fish can live. Further than this, the sinking of the land has made many banks in the sea, which, rising toward the surface, reach upward into the ever-moving waters of the Labrador current laden with food from the cold north. While there are many small fishing banks near the coast, the much more extensive areas of submerged hilly land, which constitute the principal fishing banks off the coast of New England and Canada, are now of much greater importance.

In stating the effects of the sinking of the land on the abundance of food fish, it must not be overlooked that the fact that the rocks of the sunken land are hard is also of importance. This has made the coast of northern New England a rock-bound coast; for the waves have stripped off the soil from all exposed places, but have not had time enough to build extensive beaches at the present level excepting in places where the conditions are particularly favorable, especially in partially enclosed portions of the coast. Upon the rocks of the coast itself, and on the shallow sea-floor just off shore, sea-weeds form a mat of plant life which harbors a multitude of animals upon which some of the food fish can live. Had there been a sandy coast, like that of southeastern New England, this abundance and variety of food fish would have been impossible.

Landing upon a rather inhospitable coast backed by a forest-covered land, often boulder-strewn and therefore difficult to clear for farming, it is not to be wondered at that the early settlers turned their attention to the sea as a source of food. With little difficulty, either from the rocks of the coast or from small boats just off the shore, an abundance of fish could be caught, not merely for present needs, but, cured with salt, for the days when fishing would be impossible.

Individuals settled here and there along the coast, singly or in groups, clearing small patches of ground for planting, to be sure,



DRYING NETS IN A SMALL COVE ON THE NEW ENGLAND COAST.

but depending upon the sea for their principal food supply. This ever-ready source of food was one of the great aids to the early settlement of much of the uninviting shore-line of northern New England.

Such contact with the sea develops bravery; nay, it demands bravery first of all and then develops it still further. The life of the fisherman who spends his days in an open boat on the heaving sea, which may at any moment be lashed by the fury of the storm wind, is such as to demand not merely braveness, but hardiness, quickness to see, and, in emergencies, ability to judge and act with utmost coolness and fearlessness. The life of the fisherman is also calculated to develop a spirit of independence; and he must also be patient and persistent. We will never know to what extent the development of these qualities among the New Englanders, and later transplanted in other parts of the country, is to be accredited to the influence of the early life by the seashore; but for my own part I believe this influence has been great.

A LOBSTER FISHERMAN WITH HIS DORY AND LOBSTER TRAPS.

At the present time we find the lone fisherman all along the coast of northern New England, but especially in the more remote parts of the coast. He has his dory in which he goes out upon the sea every day that the weather permits. His home, often no more than a shanty surrounded by a small and not well kept garden, is on the shores of a cove which furnishes partial or complete protection to his boat. Early each morning, at an hour when most of us are abed, he goes out in his boat to attend to his lobster pots, nets and trawls, sailing when possible, rowing when necessary. His life is a simple one and his needs are few; but he is his own master, free and independent. Isolation has produced its stamp upon this man. To the stranger, he is uncommunicative; and he preserves quaint customs and words long since forgotten in other parts. But if he can be drawn out he is found to be a clear observer, shrewd in his judgment of men and affairs, probably prejudiced, and in that case unreasonable, but nevertheless a man of such qualities as the best of men possess.

FISHING SCHOONERS AT GLOUCESTER.

These scattered fishermen usually have more fish than they can use, and they sell the surplus at a neighboring market. At the present time this is usually a small village or town on some harbor where the fishing business is better developed because the harbor will protect more boats. In the very early days the gathering of surplus fish for shipment to the larger cities constituted one of the beginnings of the coasting trade which has been developed in so many directions and to such large proportions; and from the ranks of the fishermen have come, and still come, many of the sailors, for this service, and, in emergencies, even the men to man our war ships. The service rendered the country by these fishermen during the Revolutionary War, the War of 1812, the Civil War and even the late Spanish War, is not among the least important results of the fishing industry of New England.

Naturally, with fishing practically all along the coast, some places assumed more importance than others as fishing centers or markets. But until late in the present century none of these fishing ports became of superior importance. They were scattered at intervals along the coast at points where a combination of good harbor and nearness to good fishing grounds conspired to make a thriving fishing town possible.

There was Provincetown, for example, far out on sandy Cape Cod, on a moderately good harbor, but whose location was of importance chiefly because so far out to sea. Also on a moderately good harbor was Marblehead whose neighborhood to Boston gave it an advantage because of the ready market. Cape Ann early became the center of several fishing colonies around each of the harbors, especially Annisquam, Gloucester, Rockport, and Pigeon Cove. Like Provincetown these fishing ports had an advantage from their location upon a point extending out into the ocean; but the rocky coast and the neighborhood to Boston made this site more favorable for development than Provincetown. Farther down the coast fishing developed extensively at Portland, Eastport, and a number of other places where conditions were favorable.

While the primitive condition of the fishing industry, represented by many individuals fishing from small boats near the coast, has by no means disappeared, it has, as a result of the development of the deep-sea fisheries far from the coast, now become secondary in importance. While the demand for fish steadily increased the supply near at hand rapidly diminished, thus causing the search for food fish in more remote regions. A single man could engage in dory fishing; but it required a combination of men and of capital to conduct the fishing operations on the distant banks.

Therefore men combined, built vessels, manned them, and fished with them, sharing expenses, labor and profits.

The development of this modern fishing has been very well illustrated upon Cape Ann, which is today the greatest fishing center in the world. On this rocky coast there are several harbors, as stated above, but by far the best is that around which the city of Gloucester is now built; yet in the early days, when fishing was done near the coast, the poorer harbors were even greater centers than that of Gloucester. And when the change began from the primitive to the modern methods of fishing, the harbor of Annisquam was selected as the one for the development of a fishing port. This harbor, crossed by a sandbar at the entrance, and inaccessible at low water, while admirably adapted to serve the purpose of a center for small boats was very inadequately suited to the newer form of the fishing industry for which good-sized vessels were required. The result is that the piers and buildings, once the seat of activity, are now abandoned and crumbling in decay. The industry has been transferred to Gloucester, a few miles distant, where the harbor is better.

WHARVES AND VESSELS OF GLOUCESTER HARBOR AT LOW TIDE.

The introduction of railway transportation helped in this transformation. Formerly the fish were sent to Boston by ship; and, given time, a vessel could go from Annisquam to Boston; but when a railway was built that did not pass thru Annisquam this port was placed at a disadvantage compared with Gloucester, to which the railway did reach.

At present the fishing industry has become so developed and specialized in Gloucester that it ranks among the great industries of the country and there are many interesting features connected with it. The prime reasons for the importance of this city may be summarized as follows: sinking of the land has transformed the coast at this point to one of such irregularity that the harbor is excellent. It is, moreover, responsible for the fact that this cape is a projection from the land and that its coast is rocky and therefore the original home of an abundance and variety of food fish. The same subsidence of the land has transformed certain less elevated portions of the ancient land to shallow banks in the sea, and, since these are bathed by the cold northern current, conditions have arisen which are favorable to the existence of quantities of food fish.

While many of these advantages are shared by other sections of the New England coast, Gloucester has developed more rapidly than the other fishing ports partly by reason of the fact that the projection of Cape Ann into the sea has been favorable to the development of a sturdy race of fishermen at one of the points on the coast nearest the fishing banks, and at the same time near the market and distributing point of Boston. For very good reasons Boston itself has not developed the fishing business to the extent that Gloucester has done, among these reasons being the fact that Boston has had a multitude of interests while Gloucester has but one; namely, fishing or industries dependent upon fishing, as the manufacture of glue, twine, nets and anchors. It is a case of specialization; yet Boston has found the opportunity for the development of a considerable fishing trade and has even threatened the supremacy of Gloucester.

It has been said earlier in this article that one of the characteristics developed by the fisherman's life is that of independence. The truth of this is well illustrated by the present conditions among the fishermen, some aspects of which are so admirably portrayed in Kipling's "Captains Courageous."

Long since, the demand for fishermen in Gloucester has far exceeded the supply of local fishermen; and consequently men have flocked there from many points, as the coast of Maine, Nova Scotia, Prince Edward Island, Newfoundland and the Portugese Azores. Nevertheless, with all this diversity of race, they are banded together as partners, as their predecessors were when fishing two in a boat. The men are not hired by the owners of the fishing vessels at so much a day, but they are banded together as partners in a common enterprise. A firm may own dozens of vessels, and these are fitted out with the necessary apparatus and food, each man being charged with his share of the expense of outfitting. When the trip is sold these expenses are deducted, the firm bearing its share, and then the profits are divided, the firm naturally getting the larger portion, since it has supplied the vessel and the largest part of the outfit, and the captain, or "skipper," receiving more than the men. The result is that each man feels a keen interest in the success of every trip; and, barring the element of luck, his share bears a direct proportion to the energy with which he and his fellows work. All considered it is one of the most satisfactory and successful instances of co-operation between labor and capital that the industries of our country offer. There are no strikes.

A TYPICAL GLOUCESTER SCHOONER.

The captain is an autocrat, directing the movements of his ship as he deems wisest, selecting his crew from the best available fishermen and yet treating them all as *men*, and, up to a certain limit, as equals. A lazy fisherman, or one who causes disturbance while on a trip, needs to find a new captain the next time; and the skipper who is not fair to his crew, nor energetic in his work, is obliged to select his men from among those whom better skippers have no desire to include in their crews.

The results of fishing have an element of uncertainty that is at times discouraging, but that nevertheless adds a zest which appeals to that type of men whom the industry itself attracts. Sometimes a trip does not pay expenses; but again, in a week, a fisherman may receive a share of one hundred or even two hundred dollars. Many of them spend their shares soon after reaching shore, and often in very questionable directions; but among the Gloucester fishermen there is a large proportion who are steady men with families to support. That the industry is on the whole a profitable one is proved by the fact that most of the skippers, and many of the common fishermen, own their own houses. One of the peculiar sides to this industry is the fact that the profits bear little direct relation to the financial condition of the rest of the country. These profits depend largely upon the catch, and fish are as likely to be abundant in hard times as in the more prosperous periods.

A Gloucester fishing vessel of the present day bears a closer resemblance to a private yacht than to a fishing boat of half a century ago. It is so built as to combine sea-worthiness with speed, and in some cases the former is even sacrificed to the latter, for it is important to move rapidly from place to place, and particularly from the fishing grounds to the market. Often to be the first of a number of vessels to reach port makes a difference of hundreds of dollars in the profits of the trip.

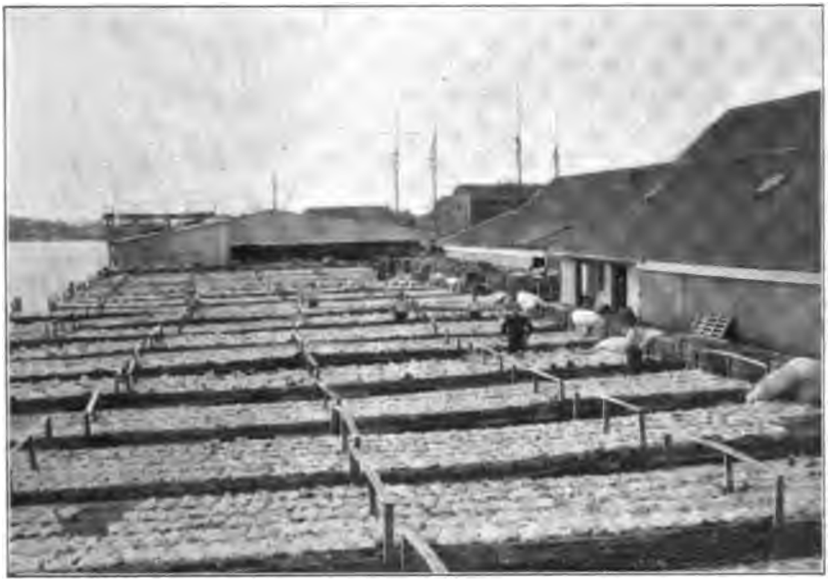
The internal arrangements of the schooner also bear a certain resemblance to a private yacht. There are all the necessities that could be desired and even some luxuries; for example, from tanks built into the ship, water is led into the basins by faucets and a high grade of plumbing is employed. There are pictures and ornamentation of wood work in the cabin. The fishermen also demand good food; and a list of provisions that are commonly furnished to a fishing vessel would surprise most readers. It is commonly supposed that sailors live upon salt pork and hard tack; but the Gloucester fishermen carry fresh meat and fresh vegetables and the very best brands of canned goods. It is doubtful if many workmen in the country have better food than is supplied to these fishermen.

The life of the fisherman is full of hardship and danger. The summer fishing for mackerel is pleasant, the boats cruising near the coast in the exciting search for schools of mackerel, which, when sighted, are chased with large seine boats and then surrounded with the seine and taken aboard, either to be salted in barrels or to be quickly taken to the market and sold fresh. This work is exciting and arduous but attended by little danger.

Some of the summer fishing is more dangerous; for small Gloucester schooners go to the coast of Ireland, Iceland, Newfoundland and Greenland. The winter fishing presents an abundance of excitement and danger. The fishing banks are notoriously stormy and foggy, and often the boats are so densely wrapped in the fog that objects only a few feet away cannot be seen. Then they are in danger of collision with icebergs and with ocean steamers, whose path lies directly across the fishing banks. It is by no means uncommon for a fishing schooner to go to the bottom, with all hands, crushed like an eggshell beneath the bows of a huge transatlantic liner. Very often the schooners are huddled together in great numbers, and then, if a storm arises, one of the vessels may be set adrift. Driven before the wind, in which sailing is impossible, the wanderer rushes aimlessly among the fleet, and, if it strikes one of the anchored vessels, the result is that two vessels and two crews are blotted out of existence, for once overboard in such a sea there is no chance of rescue. Another danger is that of being washed overboard by the huge waves which frequently break over and wash the decks of these small craft.

Many lives are also lost in open boats, for one of the most common methods of fishing on the Banks is that of trawling. This method of fishing consists in lowering to the bottom a great many hooks attached to one line and called a *trawl*. In order to set the trawl, and to remove the fish from it at intervals, men must leave the vessel in their dories. If a snow squall arises or a fog sets in while the men are out, they are apt to be separated from their schooner and, drifting about, become hopelessly lost in the open ocean. Every year lives are lost in this manner; and very often men are adrift for days before being picked up, perhaps crazed with thirst or almost starved, and frequently badly frozen.

In some years over two hundred men are lost from the port of Gloucester, and every year there are scores of lives sacrificed. The result is that the percentage of widows and orphans in Gloucester is unduly large; yet the freedom, independence and excitement of the life, added to the possibility of profit, induce men to engage in the industry. But the wives and mothers ashore, lacking the excitement, wait and watch and pray, spending sleepless nights listening to the roar of the storm waves with fear and trembling, for they know that this very storm may rob them of their dear ones. Then, when it is time for the return, they watch and listen; and, alas, in far too many cases anxiety gives place to fear, then to dread uncertainty, and finally to hopeless certainty that the vessel will never again enter port, and that no one will ever know more than that it lies at the bottom of the sea.



DRYING CODFISH ON THE "FLAKES" AT GLOUCESTER.

When the fish are brought to the land many are sold fresh and distributed over the country. Each day, for example, a baggage car with fresh halibut, packed in ice, leaves Gloucester on a regular passenger train. Many of the fresh fish are also landed in Boston, and even in New York, for distribution. The fresh fish business of Boston is much greater than that of Gloucester, and from that city they are sent even far into the interior of the country. However, most of the fish are salted for preservation. The halibut industry is mainly a fresh fish business; and for weeks, and even months, the fish are kept fresh, packed in ice in the hold of the vessel. Some halibut, however, are salted to be later smoked and sold as smoked halibut.

Most of the mackerel, on the other hand, are salted, being placed in small barrels of brine as soon after being caught as they can be split open and cleaned. Some of the cod fish are brought in for sale as fresh fish, but most of the cod are salted. When starting from port the hold of the cod-fisherman is filled with dry salt, and the attempt is made to catch enough fish to use up all this salt. As fast as the fish are caught, split open and cleaned, they are packed in the dry salt which, uniting with the juices of the fish flesh, forms a brine that soaks into the fish. That which is left finds its way to the bottom of the schooner and is pumped out. Thus, little by little, the entire cargo of salt has its place taken by fish.

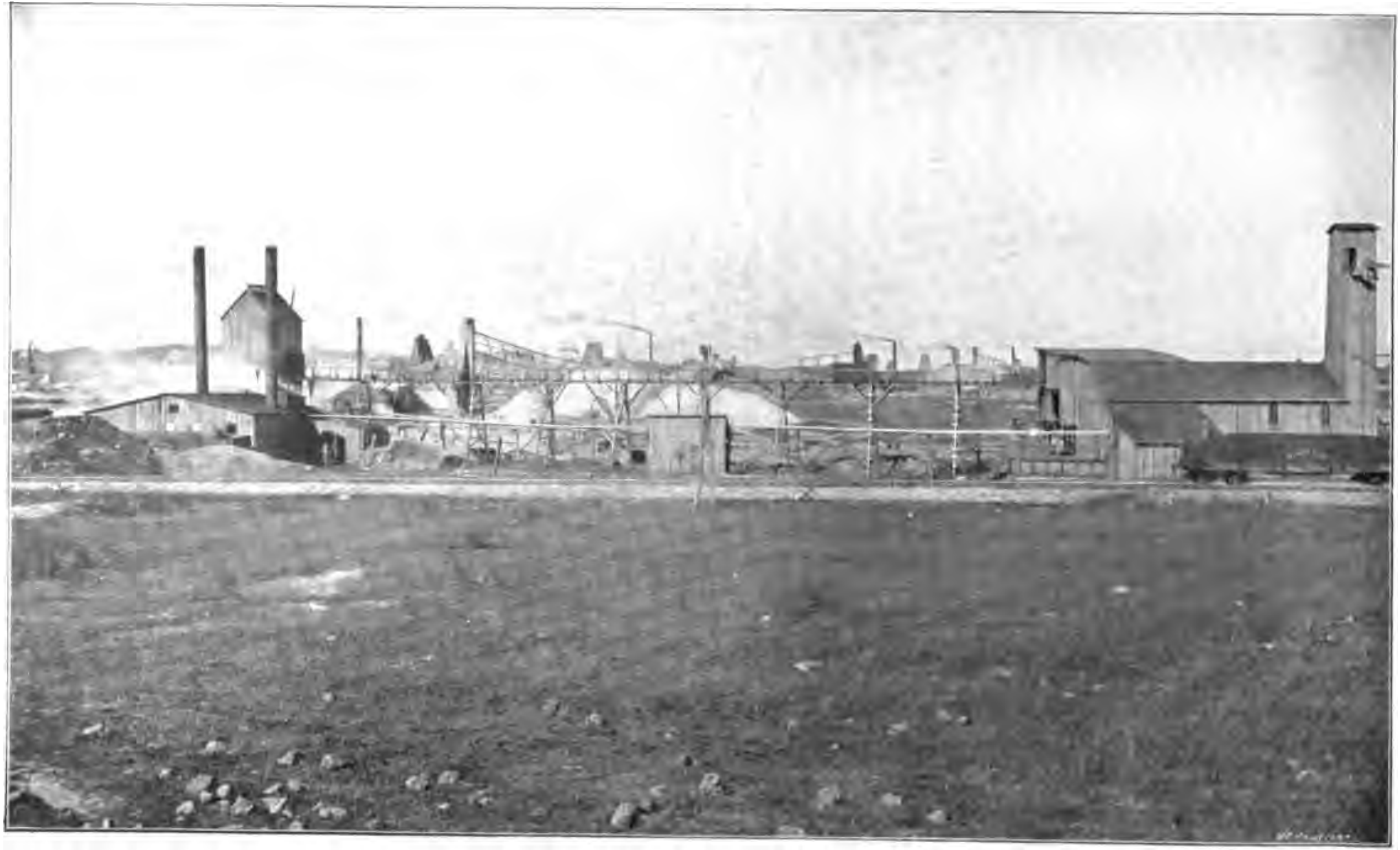
Arriving in port the cargo is transferred from the ship to the wharf where the fish are placed in large hogsheads, called *butts*. There they are left soaking in the brine until the time comes for drying them. For that purpose the fish are spread upon the flakes, which consist of frames two or three feet above the level of the wharf, upon which are many cross-pieces arranged much as laths are in a house. This permits the air to reach the under as well as the upper side of the fish. After being thoroly dried many of the fish are sent away whole to be sold as salted cod, and these fish find their way all over the country. Of late, however, an important industry of preparing the cod more carefully for the market has sprung up. For this purpose the skin and bones are carefully removed, and the fish flesh is torn into shreds and packed in boxes as boneless or shredded cod.

Formerly the fish heads, bones and skins were waste products serving no other purpose than the pollution of the harbor waters; but now this refuse finds several important uses. Some of it is made into guano for fertilizer, but great quantities are employed in the manufacture of glue. LePage's glue, famous over the land, is manufactured from the refuse of the Gloucester fishing establishments.

Every year the fishing industry is growing and there is more and more concentration in a few large ports, particularly Gloucester and

Boston. There have been times when the competition of Canadian fishermen has severely threatened the prosperity of the Gloucester business. There has also been an attempt to develop the Alaska and Pacific coast fishing in competition; but the distance from the eastern market has interfered with the success of this industry. The latest influence upon the Gloucester fishing business of marked importance is that which has resulted from the Spanish war. Catholic countries furnish an important market for salt fish, and our recent acquisition of Porto Rico, together with our new relations with Cuba, promise to open up a large market for American fish which has hitherto been of little use to us.

This article has been long. It contains many details, some only indirectly geographic. If it serves the purpose I intend, it will give a fair idea of the fisherman's life, the causes which have made this life possible, and the results which his industry brings forth. But aside from this, and one of the primary points I have had in mind, it will show how an industry is developed as a result of the influence of a combination of causes. And among these causes the physiographic are most numerous and important. The ocean home; the food-bringing currents; the banks, submerged highlands; the rocky coast due also to land sinking; the irregularity of the coast and the consequent harbors due to the same cause; the very winds that drive the vessels,—these have conspired to make it possible for man to obtain this important food supply for his fellow men, and thus to build up an industry which determines the existence of cities, towns, and villages.



ORONOGO, MO., LEAD MINES.

THE LEAD AND ZINC FIELDS OF THE OZARK UPLIFT

BY WILLIAM H. JOHNSON, FORSYTH, MO.

Lead and zinc, today, are mined out of the same shaft, crushed thru the same rolls, and only separated at the jig tanks. The lead mine may also be a zinc mine. But a short time since this was different. Thirty years ago zinc was not recognized as a valuable ore in what is now the great mining camp of southwest Missouri. It was thrown aside when encountered by miners in search of lead. Today, zinc is the ore sought and lead is accepted as merely an associate ore.

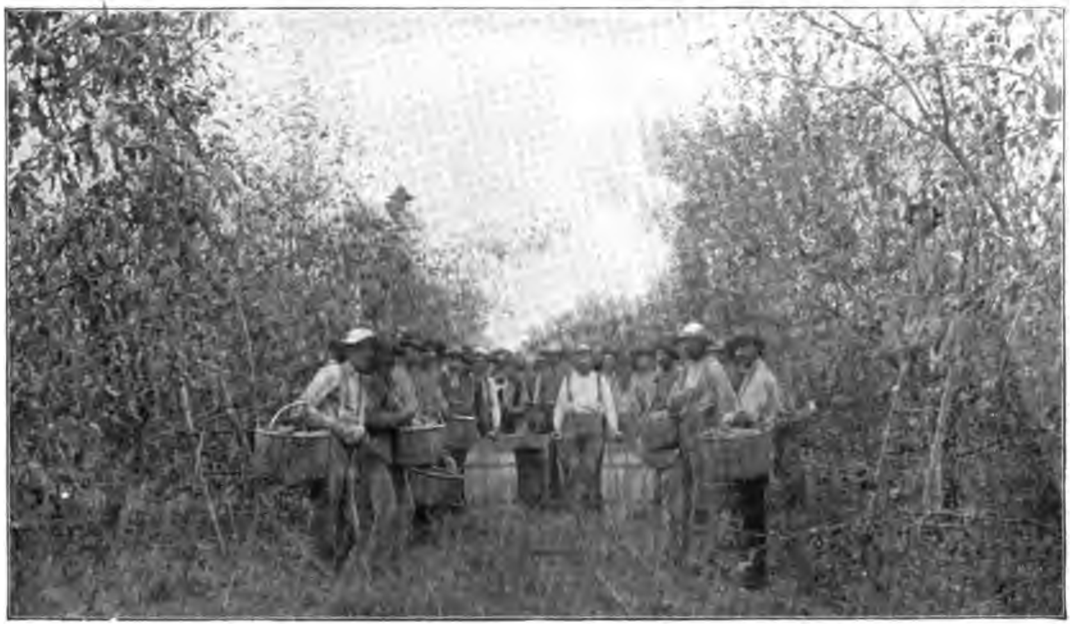
Lead was mined thousands of years before zinc was thought of. In the days of the Pharaohs lead was smelted and manufactured into many useful articles. The Chinese were familiar with this metal more than two thousand years before Christ. The Romans manufactured it into armor, bowls, pots, water-pipes, coffins, vases, and also used it in masonry. The earliest history of the European nations mentions the use of lead. It was mined in Jamestown in the days of John Smith. There is scarcely a state in the Union which does not produce some lead ores. In southeast Missouri the famous Mine La Motte was opened nearly two centuries ago and has produced lead steadily to the present day.

Zinc is a modern metal. It was not recognized until the Thirteenth century. In the Sixteenth century white vitriol, sulphate of zinc, was manufactured, but not until the Eighteenth century was it intentionally produced for commerce. In 1743 at Bristol the first zinc works were established, the process having been borrowed from the "heathen Chinee;" but it was not until seventy years later that the manufacture of zinc became a commercial success. The first zinc smelter in Missouri was established in 1867 at Potosi. But at that time the price of zinc was so low that it was not mined for the market. The zinc buyers of those days collected their ore from the dump of the lead mine, paying a small royalty for that privilege.

The great mining district now known as the Kansas-Missouri-Arkansas mining camp was practically unknown thirty years ago. Today some sixteen counties—ten in the southwest part of Missouri, two in Kansas and four in northern Arkansas—are producing more zinc and lead measured in dollars than Alaska produces gold. In 1870 the mines of this district produced less than $100,000. In 1899 the total output for this same district exceeded $10,000,000; and yet, owing to a lack of transportation, at least three-fourths of the district was not drawn upon.

The Kansas-Missouri-Arkansas mineral district embraces Cherokee and Crawford counties in Kansas; Jasper, Newton, Lawrence, Barry, Greene, Christian, Taney, Stone, Ozark, and McDonald in Missouri; and Carroll, Boone, Marion, and Baxter in northern Arkansas. Scattered over this area are a score of individual camps each of which has characteristic features peculiar to itself. The two Kansas counties, with Jasper, Newton, Lawrence, Greene, and part of Christian in Missouri, comprise a high rolling plateau, diversified with forests of oak, and open prairies now covered with comfortable homes, farms, and orchards. It is in the great fruit belt of Missouri, famous for its "Big Red Apples" and strawberries. The elevation above the sea is some 1,400 feet; the climate is all one could desire. Modern cities and well-built towns lie adjacent to each mining camp. The line of the Frisco railroad marks the water-shed between the Osage and White river basins. To the north and west the valleys are broad, sloping gently to the Osage river. To the south and east the country breaks precipitously into deep and narrow valleys drained by the White river.

A trip thru this section in one of the luxurious observation cars of the St. Louis and San Francisco railroad is very interesting. Leaving St. Louis at night, the mining district is reached by sunrise. The country will, however, suggest no feature of the camp, as none of the mines are within view of the railroad. The tourist will be charmed with the fertile prairie farms and vast apple orchards. At Springfield he will find a modern city with beautiful homes and all the conveniences of rapid transit. Here are the residences of many of the rich mine owners of this district. Big institutions that draw their support from the mines are located at Springfield, not the least of which are the immense shops of the St. Louis and San Francisco railroad—that artery of commerce which reaches almost every camp in the district. The shops of one other railroad are



FRUIT GATHERERS.

located here also, besides several factories for the manufacture of ore mills and mining machinery. Here is the famous Drury College with its broad campus and elegant buildings, besides a score of other noted schools, including the magnificent high school building.

Leaving Springfield several small mining camps are passed, notably at Republic and Billings; but this will not be observable from the train. A magnificent farming country is traversed, and in forty minutes the train sweeps around a curve and the famous mining camp of Aurora lies before you.

THE AURORA CAMP.

To one who has never visited this district, it is impossible to convey an idea of the interesting objects to be seen here. Not long since, the town of Aurora was an unknown country village surrounded by productive farms. Today these same farms have lost their agricultural features forever. Mountains of rock and debris have converted their once monotonous features into miniature Alps. Millions of tons of rock have been removed from the bottom of a thousand yawning shafts and are piled up in immense heaps some of which cover many acres, extending fifty or sixty feet in height. Busy mills crush the pay rock and separate the ore from the chat. By day and night, in shifts of eight hours each, the miners delve in the shafts and drifts; tubs of ore ascend as rapidly as steam and electricity can handle them. The ore is dumped on a platform and passes thence to the rolls; powerful iron jaws crush the rock and flint to powder; thence it passes over the jigs. where the ore, mixed with water, is given a vertical motion until the heavier particles of lead and zinc arrange themselves below, and the lighter particles of rock, coming to the surface, are carried away to be piled up in immense heaps without. These great mountains of chat have become typical "white elephants." They have grown in extent until they threaten to engulf the very mills themselves. A feeble effort has been made to haul this crushed stone to the various towns and cities in the district to be used for macadamizing. Altho hundreds of miles of excellent streets and roads have been built and are being built in this section, the mountains of chat are increasing rapidly.

From Aurora the railroad again traverses thru miles of charming rural scenery to Monett. Here is a parting of the ways. Our train is separated into three sections, each of which is attached to an awaiting train. One of them will go to Arkansas and thence to Texas. When we are ready to visit the north Arkansas part of this district we shall take this route. The second train goes thru the old mining camp of Granby where zinc was first recognized and where lead was mined sixty years ago; thence it goes to the beautiful Indian country, Oklahoma. The third and last route is the one for us, where, still traversing the orchards and fields of Lawrence county, we flash thru the prosperous mining camp of Wentworth.

Now the mines become more frequent. Here and there dotting the rural scenes are isolated mills and fresh prospects. Every stage of mining development may now be noted—the white tent of the prospector, where his faithful wife is rearing a brood of tow-headed youngsters who may be seen scrambling about the door of their frail domicile, is within easy call of the "prospect," where the husband, assisted by one or more clay-besmirched "pards," is laboriously sinking a shaft. What keen hopes of success and visions of future wealth sweeten his labors. Tomorrow if you pass this way again you may find upon this site a prosperous mining plant and may have some one tell you that there was where "Bill Smith got his start" and that Mr. William Smith now resides in Carthage, enjoying the thousands that annually pour into his coffer; or perhaps you will find the prospect abandoned, with weeds o'ergrowing the spot and have some one inform you that that was where "Bill Smith 'dropped his wad' " and that he is now gone back to Kansas to his "wife's people"; for such is life in the mining camp.

From Wentworth to Carthage is scarce an hour's run. Now we are among the aristocracy of the "Joplin camp." When a man "strikes it rich," he goes to Carthage to live. Here are the beautiful homes and spacious lawns of the zinc millionaires who do not live in Boston. But the train speeds on past the rock quarries of

Spring river into the heart of the greatest zinc mining camp of America—the Galena-Joplin camp—thru Oronogo, Carterville, Webb City and Joplin, and thence a short run to Galena.

Mines are upon all sides of you; with heaps upon heaps of rock and mountains of chat; smoke of the mills rising from every point of the compass; electric lines binding the entire camp into one great straggling city; thousands of families living in tents for the want of houses to accommodate them, seeking that fortune which, tho in apparent reach of all, is, nevertheless, realized only by a few.

On Saturday night the business streets of Joplin form one of the great curiosities of the camp. The miners and their numerous families pack and jam the business thorofares till they resemble the scene of a fête. In the mining camp all business is settled and all balances made on Saturday. Ore is sold on this day; men are paid, and there is a general balancing of all scores; banks are open until 10 o'clock p. m. Joplin is the shop, the factory and the supply point of the camp, and while it has many beautiful residences, it is the home of the employe rather than the mine operator.

EMPIRE SMELTING WORKS.

Here also we encounter our first lead and zinc smelters. It is at this point that the producer and consumer meet. The greatest zinc mines of America elbow the largest zinc smelters of the western hemisphere. Further west in the gas and coal belt of Kansas, along the Frisco line, are other smelters which convert the ores of this district into marketable spelter. A visit to one of the big zinc smelters of this district is highly interesting and instructive. You can note the process by which the sulphur is roasted from the zinc and thence liberated by a flux of carbon, which under great heat combines with the oxygen that has replaced the sulphur in the roasting process. But our field is too broad to justify a minute description of the smelters in this brief article.

We leave the Joplin camp, change cars at Monett, and proceed thence, via the picturesque health resort of Eureka Springs mid the cedar mountains of White river, thru the tunnel which divides the limits of the Kansas-Missouri district from that wonderful region of north Arkansas.

EUREKA SPRINGS.

We are now upon a new road which penetrates the most remarkable section of America, where zinc is not mined at the bottom of black shafts, but is quarried from the mountain-side in the full light of day. When we have taken up the geological feature of this section, you will understand why they delve for zinc at Joplin and quarry it from the mountain-side at the Morning Star. It would not be possible in our limited space to visit the numerous interesting mines and natural curiosities of Boone, Marion and Baxter counties. The mining in this region in many respects is a duplicate of the early days in Colorado. Here you will find the typical miner's cabin perched on the mountain-side or lost in the deep shadows of the gulch. You will hear them talk of "staking out claims," and "doing assessment work," accompanied by the usual vernacular of the western mining camp.

Unlike the Joplin district, with its stretches of farm lands and orchards, the landscape of north Arkansas is mountainous and in many places grandly picturesque. Streams of crystal waters wind tortuously beneath overhanging bluffs; the valleys are narrow but very fertile. The entire landscape presents almost an unbroken forest of pine and oak. In some localities, however, especially in Boone county, large areas have been cleared up and now support productive farms and orchards. Dotted thruout this section are substantial towns, generally in picturesque locations. The famous mines of north Arkansas are not duplicated elsewhere, except in the southern part of Missouri, especially in Taney county. At the Morning Star, several hundred feet above water-level, the ore deposit, principally of zinc carbonate, has been exposed for more than a thousand feet horizontally, with a varying thickness up to

NARROWS OF THE WHITE RIVER.

fifty feet. Of course this is not solid ore, but carries the mineral in veins and pockets, permeating the ledge in all directions. In north Arkansas are fully four hundred or five hundred mines and prospects of a similar nature, where the ore is either mined against a perpendicular face, or by drifting back into the mountain.

The railroad from Eureka Springs to Harrison is just completed. A flood of people, all seeking their fortune in one manner or another, is pouring into this region. While many are coming by rail, there are thousands arriving in every imaginable kind of conveyance. They are overflowing the towns, and prospecting every gulch and hollow for mineral. Here, as at Joplin, fortunes are being made almost between two suns. The very air seems to quiver with excitement.

NEAR EUREKA SPRINGS.

The railroad terminates at Harrison; from thence remoter parts of this interesting section must be reached by means of carriage or on horse-back. From Marion county thru Baxter in

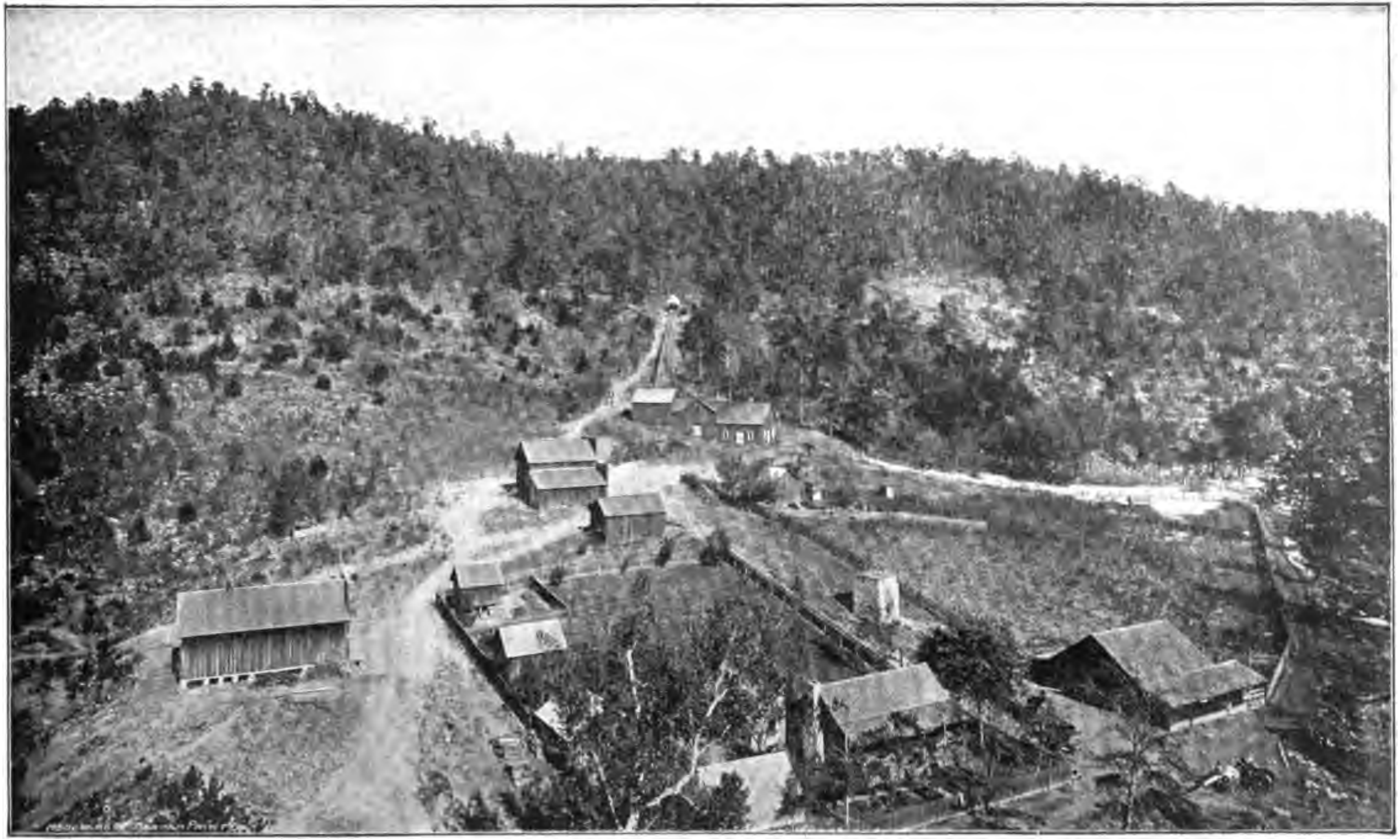
Arkansas and Ozark in Missouri, the route lies thru picturesque valleys and over rugged mountains. At every turn may be seen the prospector in search of ore. Mineral has been discovered and prospects developed in the most inaccessible places, where at present the expense of freighting the ore precludes the possibility of any revenue. But men are willing to wait for transportation, feeling proud of their possessions and the knowledge that some day—tho that day may be remote – they will enjoy wealth. Many of these mining prospects, altho not productive of any revenue at present, and may be not for years, nevertheless, are changing hands at fair valuations. Some of them fifty miles from a railroad have been sold for large amounts ranging up to a hundred thousand dollars.

In Taney county another scene of activity is presented. The Chadwick branch of the Frisco railroad is about to be extended south thru Taney and Marion counties. The miner and prospector are hurrying in, to secure footholds before the advent of the railroad advances land values beyond their reach.

That peculiar geological feature, a fissure known as the Ten O'Clock Run, penetrates the southwestern part of Taney county. Along this break and on either side thereof for several miles are numerous deposits of zinc ore. The Pine mountain sub-district, like the north Arkansas camps, shows the same spectacular exhibit of zinc carbonates.

Passing up thru Taney county into Christian, we find an old and still prosperous camp in the Elk valley south of Ozark, where lead was mined and smelted fifty years ago. Thence by rail to Springfield, and our brief and hasty tour of the Kansas-Missouri-Arkansas district is complete.

Having journeyed over the surface, we will now investigate the geology of the district and the formation of the ore deposits. At an early period in the geologic history of America the region now occupied by the Kansas-Missouri-Arkansas mining district was a shallow sea upon whose bed were deposited hundreds of feet of limestone. Zinc and lead, which are widely distributed in nature, and which have not only been identified in all the country rocks of this region but have also been detected in minute quantities in both fresh and salt water as well as in plant and animal life, formed a part of these thick strata. The rock in this section ranges from the Cambrian thru the Silurian to and including the

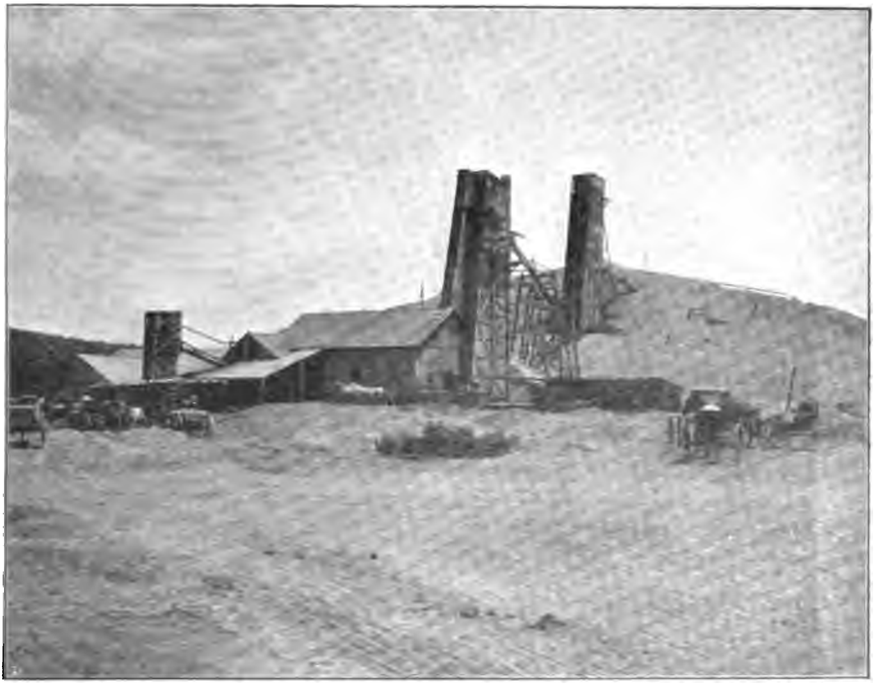


MORNING STAR MINE, MARION CO., ARK.

Subcarboniferous. The Silurian rocks are characterized by alternate strata of close-textured limestone, chert, sandstone and shale. The limestones contain a considerable percentage of magnesia; they are frequently fine-grained, but coarsely granular or crystalline varieties are abundant. The cherts are less abundant than the limestones, but being comparatively indestructible are apt to accumulate wherever the surface rock has been extensively eroded. Considerable quantities of chert may be found thruout many parts of the district, especially in the southwestern part. They are indisputable evidence of vast erosion in the past. The Subcarboniferous limestones which form the country rock in most of this district, are closely crystalline, contain abundant crinoid stems and other fossils, and burn readily into lime. Alternating with the limestones are beds of shale and strata of sandstone and chert.

At one time, the Missouri-Kansas-Arkansas mining district was a level plain, the bed of an ancient ocean, which may afterwards have been covered in places with the dense vegetation peculiar to the Carboniferous age, as there are yet traces of coal deposits in many places thruout this district. At an early period internal forces elevated the rock along a northeasterly and southwesterly axis, forming what is now the watershed between the Osage and White river basins. The strata dip to the west, the Subcarboniferous rocks disappearing under the Carboniferous strata of Kansas. To the south and east the streams have cut deep channels. In many places in the southwestern part of this district the Subcarboniferous rocks have disappeared and the Magnesian series beneath is deeply eroded. The boundaries of the Subcarboniferous rocks are marked by well defined escarpments averaging at least two hundred feet in height, and where the next formation below has been cut thru by the drainage channels it is also marked by similar escarpments. One of the characteristic features of the limestones of this section is their readiness to disintegrate under the action of solvent agents: thus a crevice which permits the entrance of solvent waters may in time become a vast cavern. A vertical fissure extending to great depths becomes a chimney, on either side of which, at various levels, spacious caverns are formed by the slow dissolution of the wall rocks. In time as the strata are dissolved these openings become filled with chert and clay—the residuary matter of the former thick overlying lime rocks. The zinc and lead which are disseminated thru the original strata are carried down in solution thru these openings, and are concentrated at the base and along the sides of these underground passages.

Sometimes solutions carrying zinc and lead act as solvents upon the limestone thru which they percolate, taking up lime and depositing the metallic substances. This may continue for long periods until the lime rock is completely changed. The forms of the deposits are irregular, frequently ramifying for hundreds of feet, narrowing to mere veins, and again broadening out to immense chambers. In the Joplin and Aurora camps these cavernous deposits are encountered at various depths—from a few feet to several hundred beneath the surface, and so vast are some of these rooms that many hundred thousand dollars worth of ore have been removed without exhausting the deposit. In Stone, Taney, and Ozark counties in Missouri, and in Carroll, Boone, Marion, and Baxter counties in Arkansas, the erosion has been so much greater, and the streams have cut such deep channels that the water-level is some six hun-



EMMONS MILLING CO., SLEDGE MILL, GALENA, KAN.

dred feet lower, geologically as well as topographically, than it is in the Joplin sub-district. Here the original ore deposits in the Subcarboniferous and Upper Magnesian limestone are left above the ancient water-level, where they were deposited thru the same agents that formed the Joplin ore. In this region the space between the mountains from summit to summit represents the work of past erosion. The ores, both disseminated and concentrated, which were once in place above the valleys, have been carried down and re-deposited wherever they found open ground beneath; therefore in this section the prospector looks for ore from the mountain-top to the valley, and finds rich deposits by shafting down beneath present water-levels.

In the Joplin district three principal grades of ore are mined for commerce: Lead, "silicate," and "jack." Silicate and jack are the miners' names for Calamine and Sphalerite.

Native lead is not found in any of these camps. Galenite, lead sulphide, is blue-gray in color, opaque, with bright metallic luster. Its gravity is 7.4; hardness 2.5; melts at red heat and volatilizes at white heat; crystallizes in the common form of a cube or a cube-octahedron. It is a compound of lead 86.6 parts, and 13.4 parts of sulphur. It is never found pure in nature, always being in combination with silver, copper, zinc, antimony or bismuth and sometimes gold.

Calamine is zinc silicate, being 67½ per cent. zinc oxide, 7.5 per cent. water, and the balance silicate. In color it ranges from pure white to yellow, brown and bluish.

Sphalerite, commonly called "blende" or "jack," is the principal ore mined in the Joplin district. When pure it is colorless; but it is more often found yellow, brown or black, often green, gray and bright red. The composition of pure Sphalerite is thirty-three parts sulphur and sixty-seven parts zinc. It invariably contains as impurities, iron, copper, manganese, and sometimes silver. Its various shades of color are due to the impurities.

The principal ore of the north Arkansas district is Smithsonite —zinc carbonate. Smithsonite, however, is found thruout the entire district, but in the southern part of Missouri and the northern part of Arkansas vast deposits of this ore are encountered in connection with Calamine, Sphalerite, and Galenite. Smithsonite is normally white, but often gray, yellow, brown, even green and blue. The variety "Turkey Fat" is bright yellow. Pure Smithsonite is composed of carbon dioxide 35.2 parts, and zinc protoxide 64.8 parts, containing 52.3 per cent of zinc. It is claimed that some forty-eight varieties of Smithsonite have been identified in the north Arkansas camps, but it is very probable that there is no essential difference between these varieties except in the degree of impurities found associated with them, and which occasions the variety of colors and difference in crystallization.

At least fifty per cent. of all the zinc ore produced in the United States is mined and smelted in the Kansas-Missouri district, but none of it is consumed within the area mentioned. The uses of zinc are many, principally for electrical and galvanizing purposes; but it is not the province of this article to enter upon a description of the numerous uses of zinc spelter.

Before concluding, I desire to acknowledge my indebtedness to Mr. Bryan Snyder, General Passenger Agent of the St. Louis and San Francisco Railroad, for the illustrations which embellish this article. They are selected from views used in illustrating attractive descriptive publications issued by the department under Mr. Snyder's direction, and distributed gratis to anyone interested in this section, upon application to him at St. Louis.

THE CANALS AND LOCKS AT SAULT STE. MARIE: THEIR DEVELOPMENT AND IMPORTANCE

BY E. E. FERGUSON, SUPERINTENDENT OF SCHOOLS, SAULT STE. MARIE

The early explorer found, stretching southeastward from the head of Lake Superior, one continuous waterway nearly twelve hundred miles in length, the only barrier to the successful navigation of which were the rapids connecting Lake Superior and Lake Huron. Here, within the distance of a mile, the cool and crystal waters from Superior rushed splashing and dashing down a decline of about twenty feet.

No boat was powerful enough to ascend its turbulent waters and no pilot skillful enough to direct his cargo down its rocky channels. Hence for years freight was brought to the head or foot of the rapids, and carried by portage to boats awaiting to take it forward on its journey.

But as the extensive mineral resources of this upper section began to be discovered and demanded in the markets of the world, methods were advanced for overcoming the great loss of time and money caused by the portage at the "Soo" rapids. Immediately upon the admission of Michigan to statehood, Governor Mason called the attention of the state legislature to the advisability of constructing a ship canal and locks at the rapids. He claimed it would not only expedite traffic, but would facilitate in the opening up and development of the state. As a result, the legislature passed an act March 22, 1837, appropriating $25,000 to be expended for plans, estimates and surveys for a ship canal. The affair was taken up with dispatch, and, in less than a year, the governor reported to the state legislature that a canal and two locks could be constructed for about $115,000. That body at once made the required appropriation, and the following year the contract was let and work was begun. The proposed right of way touched a tract of ground owned by the national government upon which Fort Brady was located. As the commander of the fort made strenuous objections and was sustained by the national government, the work had to be abandoned.

Five years later, in 1843, the legislature, beginning to see that such an improvement would be not only a local but likewise a national benefit, asked Congress to assist in the enterprise and make an appropriation for the work. This was refused as were likewise similar requests made during the next decade.

EXCAVATING FOR THE CANAL.

During these years the mineral discoveries of the Upper Peninsula surpassed the fondest hopes of the most sanguine mine owner, and the people of that section began to realize that a ship canal at the mouth of Lake Superior was an absolute necessity. As a result, a committee from Michigan spent the winter of '51 and '52 at Washington, trying to secure the passage of two bills,—one to grant 750,000 acres of land, the other to appropriate $500,000 to assist in the construction of the canal. Altho only the first bill was passed, nevertheless the state government was not discouraged, but immediately took steps toward the fulfillment of their cherished plans. In June, 1853, work was begun and in less than two years the canal and locks were completed. The canal was 5,400 feet long, 100 feet wide and 12 feet deep. The locks, two in number, were 350 feet long, 70 feet wide, and 11½ feet deep over the miter sill. The entire cost was very nearly $1,000,000.

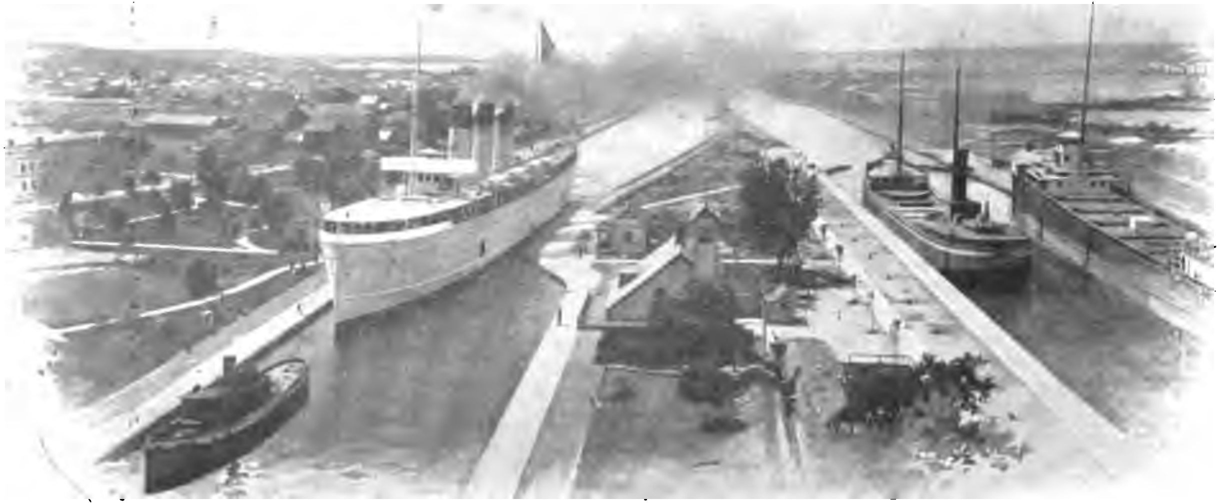
Altho the plans as carried out were nearly four times as extensive as those at first proposed, nevertheless the added impetus caused by a continuous passage from Lake Superior to Lake Erie so increased the traffic that in a few years it became evident larger locks were necessary. During this time the locks were owned and operated by the state,—a small toll being charged each vessel; but as the future possibilities of the locks, and the demands of the trade, began to dawn upon the governor and the legislators, they passed a resolution setting forth the importance of the work and urging Congress to assume charge. As the canal was then owned by the

STONE PLANERS: PREPARING THE STONE BLOCKS FOR THE CANAL.

state, it was first necessary to arrange the transfer of the state's interest to the national government, which was done by the legislature in 1869. The following year the national government, under the efficient direction of General Poe, began a systematic investigation of the conditions and needs. Later the supervision and construction were transferred to General Weitzel after whom the first national lock was named. The work of deepening the canal and building the lock consumed eleven years, and was completed September 1st, 1881. This lock was constructed on a different and more extensive plan than the one built by the state. A single lift took the place of the two, and thus time was saved. The lock, which is still in use, is 515 feet long between gates and has a lift of 18 feet. The cost to the government of deepening the canal and constructing the lock was $2,150,000.

As the Weitzel lock allowed boats drawing 17 feet of water to enter, the shipping interests at once advocated the advisability of deepening the shallow places in the channel along the lakes to the same depth. Before this improvement was completed, the volume of commerce had so increased that it was evident more and larger locking facilities would have to be furnished. It was not an uncommon sight to see vessels lined up for half a mile both above and below the locks, awaiting their turn to be locked thru. As vessels frequently had to wait from twelve to thirty-six hours, the aggregate loss in time and carrying power was very large. When this condition was brought to the attention of the national government, General Poe was asked to investigate and make a report. He did so, and in 1886, plans were submitted which provided for an additional lock and a deepening of the canal to twenty feet. The plans were favorably received and adopted, so that on May 4, 1887, active operations were begun on the new or Poe lock.

A bird's eye view of the canal, locks and surroundings is shown in the cut on the following page. On the left may be seen the government park with its curved walks and well kept grounds. In its rear lies the western part of the city of Sault Ste. Marie, Michigan, with a large tourist's hotel, the Iroquois, in the foreground. To the right of the locks are the Sault Rapids with the International railroad bridge in the distance. Extending thru the center of the picture are the canal and locks. The canal which leads from the lower end of Lake Superior to the locks proper is shaped like the letter Y. In order to divert the course of the water, and lead it up



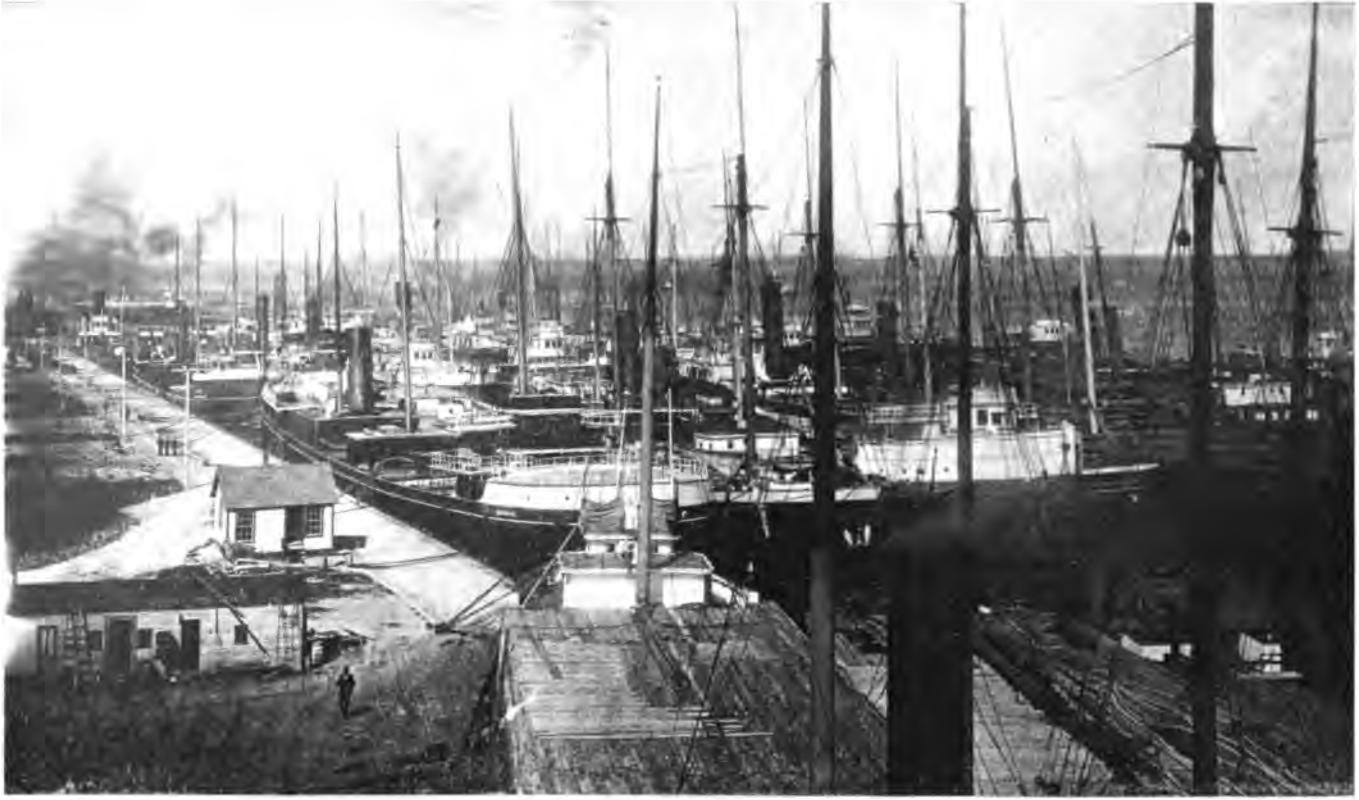
GENERAL VIEW OF THE AMERICAN LOCKS AT SAULT STE. MARIE.

to the locks, it was necessary to construct thru the solid rock this canal which is twenty-five feet deep and over a mile in length. The left hand arm of the Y leads to the Weitzel lock; the right hand arm to the Poe. The picture which is intended to show the relative location of the different places, necessarily represents each part on a small scale. The small boat, or tug, appears like a toy, yet it was probably seventy-five feet long. When this comparison is taken into consideration, a better idea can be gained of the size of the other three boats and the capacity of the locks.

If the reader has never seen locks in operation and has as meager an idea of the way they are operated as the writer had at one time, a description of the method of operating may not be out of place. A boat from Lake Superior desiring to be locked thru, comes down the canal to either end of the Y arm. Both gates of the lock being closed, the water from the canal is admitted to the lock by means of valves. When the water in the lock is on a level with the water above, the valves are closed, and the upper gates, or those next to the boat, are opened. The vessel enters and the gates are then closed, thus cutting off any further flow of water from above. One might at first think that now would be the time to open the lower gates and allow the boat to start on its course: but a moment's reflection will reveal the fact that the captain does not desire such a rapid start as would be given the boat, were it possible to open the lower gates and allow the water to suddenly shoot down nineteen feet to the level of the water below. To overcome this difficulty, valves are placed below the lower gates, so that by opening these the water and boat in the lock gradually come to the level of the water below. When this has been accomplished the lower gates are easily opened, and the boat is ready to pursue its onward course.

When a boat wishes to pass to Lake Superior the operation is just reversed. The upper gates are then closed and the lower gates opened, so that the water in the lock is on a level with the water below. The boat passes in, either by its own power or by the assistance of a tug, and the lower gates are closed. Then water is admitted to the lock until it reaches the same level as the water above, when the upper gates are opened and the boat is ready to enter Lake Superior.

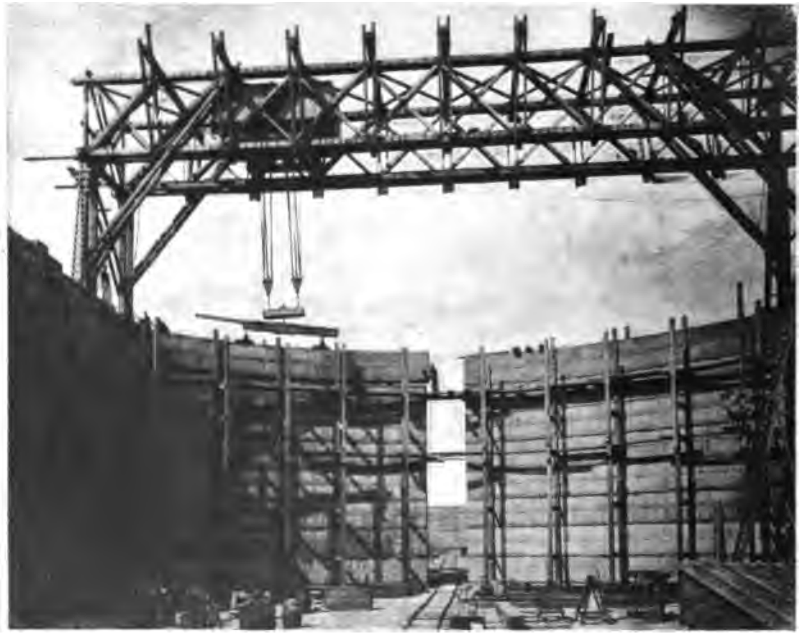
At each lockage, it is possible to pass from two to six boats, depending upon their size. When it is said that such a fleet has



BLOCKADE CAUSED BY AN OBSTRUCTION OF THE CHANNEL.

been detained by the lockage less than a half hour, but a meager idea is gained of the work that has been accomplished. If the freight carried by this single lockage had been aboard a rapidly moving freight train, the train would not have been able to pass the locks in any less time than it took to make the lockage. When it is said that the largest boats are nearly five hundred feet long and carry upwards of eight thousand tons, the true importance of the facts are again apt to be underestimated. The mind does not easily grasp eight thousand, especially when it is expressed in a unit which is itself two thousand times as large as our familiar unit —a pound. If the single cargo of one of these large freighters were loaded on standard freight cars, it would require a train four miles long to transport it. Another shift of the kaleidoscope reveals the fact that it would take 11,200 acres of wheat yielding twenty-five bushels per acre to supply one cargo for this freighter, and yet by means of the locks she is raised and lowered with perfect ease, and so quickly that she is scarcely detained in her onward course. To still further appreciate the importance of the locks as a factor in commerce, one has only to think of the time and labor it would take to unload a single cargo as described above, carry it around the rapids, and reload it on another boat awaiting to carry it forward. It can safely be said that the time it would take to make such a transfer would be about five days. This being the case, a very accurate estimate of the money loss such a delay would cause is available. Last year a large freighter, the Houghton, ran aground a few miles below the locks, sank, and closed the channel to all vessels drawing more than thirteen feet of water. The blockade lasted five days, during which time only the vessels drawing more than thirteen feet of water were detained. From a detailed report compiled by the chief clerk of the locks, it is shown that the direct loss to shipping interests, exclusive of damage to boats, caused by that five days delay, was about $500,000. It must be remembered that only the largest boats were detained, and then only about as long as it would take to make a portage of the freight; hence the $500,000 represents only a part of what the locks save every five days during the busy season of navigation.

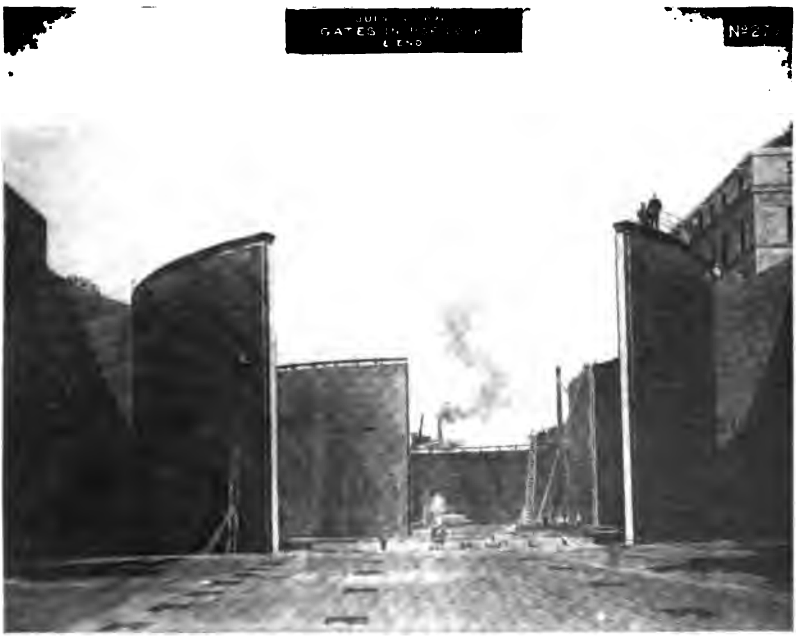
The Poe lock, in its conception, construction and equipment, is considered by eminent engineers as a model. It has the distinction of being the largest lock in the world. The lock proper is eight hundred feet long, one hundred feet wide, and twenty-one feet deep, and required a force of about two hundred men working with the most modern improved and labor saving machinery nearly nine years to complete it. The stone for the sides and walls were taken from Lake Erie and the St. Mary's river. They were brought in huge blocks and landed on the pier a short distance below the lock. Here they were sawed and planed into shape by powerful stone planers, as may be seen by referring to the cut on page 76. These blocks were then taken by means of cars and large cranes and put in their proper places in the walls of the lock.



TRAVELER ON LOCK WALLS: LOWERING ONE SECTION OF A GATE.

After the walls had been finished, the work of building the mammoth iron gates was begun. At the lower end of the lock are three pairs of gates. The outer, or guard gates; the inner, or intermediate gates; and the middle, or regular operating gates. The intermediate gates are for use in case of an accident to the regular ones. The guard gates are used when it is necessary to pump out the lock. The sections from which the gates were made, were handled by means of a "traveler" placed on the lock walls. The accompanying cut represents the machine lowering one section of a gate into place. A comparatively few men were enabled by means of this device to handle easily a section so large that it could not have been moved directly if surrounded by men.

The next figure, which shows the lower gates partly open. gives a better idea of the size of the gates, their shape and the way they are hung. The gates are built on the arc of a circumference, the convex side of which is on the side from which the greatest pressure of water comes. They are hung to the walls like an ordinary door and when opened, swing around and fit into gate recesses made for their reception in the walls of the locks. The ten-foot ladder standing against the left gate, or the height of the man on the gate at the right, furnish a good measure by which to judge of their size. The second pair of gates in the picture are the regular operating gates; the first pair are the intermediate; while the apparent wall at the farther end is the pair of guard gates, closed so as to keep back the water from below. The openings in the



LOWER GATES, PARTLY OPEN.

floor of the lock lead to valves used in emptying the locks. At each end of the lock there are six such valves, each of which has an unobstructed opening of sixty-four square feet. With either set of valves open, the locks can be filled or emptied in about six minutes.

The Poe lock machinery proper is divided into two parts, the operating plant and the pumping plant. The operating plant consists of six machines placed on the walls of the locks, and used to swing the gates: twelve engines, used to operate the valves; and two hydraulic capstans together with their necessary appurtenances. There is a machine for each leaf of the regular or working gates. By an ingenious arrangement of the cable connecting the gate with this machine, the course of a gate while being operated can be quickly reversed. The two hydraulic capstans are for use in handling vessels having no power. In the basement of the power house are located two thirty-horsepower turbine wheels, driven by waterpower. These turbines in turn drive three high pressure pumps for accumulating or storing up power while the locks are not in operation. By means of these accumulators an additional pressure of from 400 to 500 pounds to the square inch is available, and can be delivered to the engines as desired. When the expression, "emptying the locks" was used, it did not mean that the water was all removed. It simply meant that the water in the full lock was lowered until it was on a level with the water below the locks, which operation is necessary every time a boat is to enter the locks from below. Under such a condition the "empty lock" still has a sufficient depth of water to allow the boat to enter, or about twenty-one feet. For completely emptying the lock chamber, as is necessary in order to make certain repairs, there is the pumping machinery, which is also located in the basement of the power house. It consists of three centrifugal pumps each of which can discharge a stream thirty-six inches in diameter. These are driven by three Westinghouse compound engines whose combined horsepower is 1,050. Each pump while working removes 20,000 gallons of water per minute; and all working together have emptied the locks in less than three hours.

In 1892 the Canadian government began the construction of a canal and locks. They are located directly opposite the American canal, with only the rapids intervening. The work was completed in three years, at a cost to the government of about $5,000,000. As

VESSELS WAITING BECAUSE OF AN ACCIDENT.

no charge is made any vessel for lockage either at the American or the Canadian locks, and, as it is necessary for vessels locking on the Canadian side to go slightly out of their course, a somewhat larger number pass thru on the American side. During the season of 1899, eighty-eight per cent. of the freight and sixty-eight per cent. of the total number of passengers passed thru the American locks.

Several times since the opening of the locks, accidents have occurred that have prevented their being operated for several hours, or even days. The cut on preceding page was made from a picture taken at such a time. Altho a great many captains anchor in the river so as to avoid dockage, yet a glance at the long line of masts gives a person a very fair idea of the size of such a blockade. At such times the loss to shipping interests is very great. As soon as the repairs have been made, there is uneasiness among the masters of the vessels, each longing to get first place. Here, as well as during the lockage of every vessel, each boat is under the direct control of the superintendent of the locks and his assistants. The regular crew of the vessel has nothing to do except to obey orders. If such rules did not exist, the strife among the captains would be a constant source of annoyance, and the crowding for first place would lead to many accidents. The government exercises very strict surveillance not only while the boats are in the vicinity of the locks, but also while they are passing along the St. Mary's river which connects Lakes Superior and Huron. On account of the many narrow and crooked channels in this river, a boat is not allowed to pass another or to come within a quarter of a mile of another going in the same direction. Neither are they allowed to run faster than nine miles per hour while passing thru the greater part of the river. Watchmen are placed along the course to see that all boats strictly obey the regulations; and the master who forgets, or dares to disobey, usually receives, as a memory stimulator, a fine of several hundred dollars. Until these regulations were made, the truth of the old adage, "The more haste the less speed" was often exemplified. Vesselmen in their eagerness "to make time" would attempt to pass, occasionally colliding and sinking their vessels and thus putting a stop to all traffic for some time.

The records for the season of 1900 show that vessels necessarily spent 19,366 hours and 33 minutes in canal, or an average of 1 hour and 10 minutes and 59 seconds, which includes time waiting for lockage and passage thru locks and canals, the latter being 1 3-5 miles long. Other delays at canal which included taking on supplies, waiting for daylight or favorable weather, amounted to 16,298 hours and 31 minutes. The railway swing bridge across the canal has not delayed the passage of vessels in a single instance, but the total delays to trains amounted to 56 minutes by passing boats temporarily preventing the closing of the bridge.

American vessels carried 97 per cent. of the total freight, and 42 per cent. of the total number of passengers; Canadian vessels carried 3 per cent. of the total freight, and 58 per cent. of the total number of passengers. The total valuation placed on freight carried, was $267,041,959. Cost of freight transportation per mile, per ton, was 1.18 mills; average distance freight was carried, 825.9 miles; total amount paid for freight transportation, $24,953,314.71.

The following statistics, compiled by General Superintendent Joseph Ripley, will be of interest:

STATISTICAL STATEMENT SHOWING EAST AND WEST BOUND COMMERCE THRU CANALS AT SAULT STE. MARIE, MICHIGAN AND ONTARIO, FOR THE SEASON OF 1900

EAST BOUND

ARTICLES	U. S. CANAL	CANADIAN CANAL	TOTAL
Copper .... Net tons	126,671	4,395	131,066
Grain .... Bushels	15,042,161	1,022,064	16,064.225
Building Stone .... Net tons	43,912	4,990	48,902
Flour .... Barrels	6,123,246	631,630	6,754,876
Iron Ore .... Net tons	15,439,617	1,003,951	16,443,568
Iron, Pig .... Net tons	19,985	90	20,075
Lumber .... M. ft. B M.	898,093	11,558	909,651
Silver Ore .... Net tons	110	....	110
Wheat .... Bushels	31,325,693	9,163,609	40,489,302
General Merchandise .... Net tons	65,875	20,458	86,333
Passengers .... Number	16,965	12,233	29,198
WEST BOUND			
Coal, hard .... Net tons	476,131	39,384	515,515
Coal, soft .... Net tons	3,488,558	482,904	3,971,462
Flour .... Barrels	212	5,600	5,812
Grain .... Bushels	26,084	84,350	110,434
Manufactured Iron .... Net tons	97,101	18,409	115,510
Salt .... Barrels	318,358	10,537	328,895
General Merchandise .... Net tons	394,885	60,179	455,064
Passengers .... Number	19,348	10,009	29,357
Freight:			
East bound .... Net tons	19,102,494	1,429,999	20,532.493
West bound .... Net tons	4,504,860	605,720	5,110.580
Total freight .... Net tons	23,607,354	2,035,719	25,643,073
Vessel Passages .... Number	16,369	3,083	19,452
Registered Tonnage .... Net tons	20,136,782	2,179,052	22,315.834

NOTE.—In addition to the above traffic 15,500 cords pulp wood and 8,500,000 feet pine logs passed over the rapids, bound for lower lake ports.

COMPARATIVE STATEMENT OF LAKE COMMERCE THRU CANALS AT SAULT STE. MARIE, MICHIGAN AND ONTARIO, FOR THE SEASONS OF 1899 AND 1900

ITEMS.	SEASONS.		Increase. Per cent.	Decrease. Per cent.
	1899.	1900.		
Vessels:				
Steamers........................Number	14,378	14,426	....	....
Sails.................................Number	4,776	4,004	....	16
Unregistered....................Number	1,101	1,022	....	7
Passages..	20,255	19,452	....	4
Tonnage:				
Registered..................Net tons	21,958,347	22,315,834	2	....
Freight.......................Net tons	25,255.810	25,648,073	2	....
Passengers........................Number	49,082	58,555	19	....
Coal:				
Hard..........................Net tons	841,281	515,515	....	39
Soft...........................Net tons	3,099,606	3.971.462	28	....
Flour....................................Barrels	7,114,147	6,760,688	....	5
Wheat..................................Bushels	58,397,335	40,489,302	....	31
Grain (other than wheat)..Bushels	30,000,935	16,174,659	....	46
Manufactur'd and pig iron, net tons	214,585	135,585	....	37
Salt......................................Barrels	316,636	328,895	4	....
Copper...............................Net tons	120.090	131.066	9	....
Iron ore...............................Net tons	15,328,240	16,443,568	7	....
Lumber........................M. ft. B. M.	1,038,057	909,651	....	12
Siver ore.............................Net tons	487	110	....	77
Building stone....................Net tons	39,063	48,902	25	....
General merchandise........Net tons	587,484	541.397	....	8

The United States canal was opened April 19 and closed December 12, 1900; season, 238 days.

The Canadian canal was opened April 23 and closed December 16, 1900, season, 238 days.

Thanks are returned to Mr. McArthur and Mr. Fleming of the canal force, for assistance in securing the statistical information used in the article. The general views were taken by Mr. Bell of Sault Ste. Marie, and the halftones were made for the Bulletin thru the courtesy of Mr. W. R. Callaway, General Passenger Agent of the Sault Ste. Marie Railway. The cuts representing the locks in course of construction are made from the government plates.

EDITORIAL

Progress of The Bureau The Bureau of Geography began its second year on January 1st, 1901, under very promising conditions. During the preceding twelve months one thousand two hundred educational and scientific men and women, representing nearly every state, territory, and province in North America, had enrolled as active members; and about one hundred of these had expressed a desire to take part in the exchange of geographic material. The rapid increase in the number of subscribers to the Bulletin, and a generous advertising patronage made it possible to enlarge our publication from an eighty-page journal, as at first announced, to a hundred-page illustrated magazine. It is very gratifying to state that words of approval have come from nearly all parts of the world in which geographic work of importance is accomplished, and that our membership during the first two months of the new year has increased more rapidly than ever before.

Articles Illustrated With Actual Specimens A new feature for the current year is the free distribution of specimens of lead and zinc ore to accompany the article on "The Lead and Zinc fields of the Ozark Uplift". These specimens are now nearly ready and will be sent, prepaid, to all members who have enrolled on or before March 25th, 1901. We hope to be able to continue this plan of publishing articles on type products—natural and manufactured—and of illustrating them with both photographs and actual specimens. But the extent to which it will be possible to carry out this feature of the work depends very largely on the active coöperation of every member. Much can be done that will be of great value if we *all* coöperate in the matter of increasing our membership. Call the attention of *teachers*, *school boards*, and *librarians* to the merits of the Bureau. Show them that a small annual fee entitles: first, to a year's membership in the Bureau; second, to the free receipt of the Bulletin of Geography—four hundred pages a year, enameled paper, illustrated, full of helpful notes and articles; and third, to the opportunity of collecting valuable illustrative material by exchanges. Show them that membership in the Bureau is worth several times its cost, and is an advantage not to be overlooked by any person genuinely interested in geography.

Notice of Change in Membership Fee Beginning with 1902 the Bulletin of Geography will appear monthly (ten numbers a year) instead of quarterly, and several other changes and improvements will be made. Until June 1, 1901, the annual fee will remain $1.00; after June 1st the annual membership fee, including subscription to the Bulletin, will be $1.50.

Exchange Department The lists published in this number, giving approved material as well as the addresses of members offering material for exchange, indicate an increasing interest in the exchange department and a growing appreciation of its value. During the past year Mr. Philip Emerson had general charge of this department of the Bureau and did much towards making the work a success. With this number Mr. Emerson retires from the Chairmanship of the Exchange Department, and all requests for information regarding exchanges should hereafter be sent to the Director of the Bureau, Winona, Minn. Mr. Emerson will continue his active coöperation in the work of the Bureau, and articles and editorial notes from his pen may be expected in early issues of the Bulletin.

Questions Answered I have been asked to plan a laboratory course in physiography. Where can I find helpful literature on this subject?

A very helpful article by Professor W. M. Davis on "The Equipment of a Geographical Laboratory" appeared in the *Journal of School Geography* for May, 1898. Price 15 cents. Address, Journal of School Geography, Lancaster, Pa. The following articles will also prove very helpful: "Laboratory Work in Physiography" by Dr. Henry B. Kümmel, "The Use of Physiography in Geography Study" by Prof. Ralph S. Tarr, "Physiography in Schools" by Prof. George L. Collie, and "An Introduction to Physiography of Land Forms" by Prof. William C. Moore. These four articles appeared in the *Bulletin of Geography* for March, 1900. Also read "Modeling Mt. Shasta" by R. S. Holway, and "A School Orrery" by G. P. Reclus-Guyou, in the *Bulletin* for September, 1900. And consult the "List of Books, Reports and Articles Dealing with the Teaching of Geography" by J. F. Chamberlain in the *Bulletin* for June, 1900.

Where can I buy the best lanterns and lantern slides at the lowest prices?

This question is not easily answered. Low priced materials are not often the best. A very excellent lantern is made by A. T. Thompson & Co., 25 Bromfield St., Boston. The same company has the sale of a set of five hundred physical geography slides compiled by the Massachusetts Geography Club. The Bureau also has a committee at work selecting a collection of geographical slides. A preliminary report of this committee can be obtained by writing to Mr. E. R. Shepard, 2931 Portland Ave., Minneapolis, Minn.

E. M. L.

Geographic Literature

The Committee on Geographic Literature has been organized and is at work. Geographic publications, government reports, and leading periodicals have been assigned; and, where possible, all valuable articles from the first issue down to the present time will be selected. This is a work of great magnitude, and results must not be looked for at once. The plan is to bring the work up to date and keep it there. The articles will be classified so as to be in the best shape for class use. The committee will begin publishing lists of references as soon as possible.

J. F. C.

Suggestions to Teachers

The writer lately read a book entitled "*Sunny Memories of*———." In it he found the words given below: what do they mean and what country was the book about? Saheb, tiffin, Parsi, bungalow, sari, howdah, mahouts, ghee, Vedas, cashmere, rupee, chetah, Aryan, jungle, Maharajah, syces, shikar, Brahmanism, mosque, nautch, fakir, ghat, Taj, punkah.

The spring months are the best in the year to show from nature in the daily melting and freezing the effects of the sun's heating power at noon and in the early morning and late afternoon.

The explanation of these facts will naturally lead to the reasons for the heat of summer and the cold of winter, and finally to the change in the length of days and nights and the reasons for the four seasons.

It is not difficult to get a class interested in a study and comparison of the different kinds of soil to be found in the neighborhood of the schoolhouse. Talk a little about the qualities of loam, gravel, sand, and clay. Ask the children to search for the four kinds and tell you where they find each, and to bring a pailful of each kind. Plant seeds in the different soils and watch and record the results. All will thus become greatly interested. Much help will be found in this study by reading a little book called "*Talks about the Soil*," by Charles Barnard, published by Funk & Wagnalls Co., New York.

We are happy to record that field-work is rapidly growing in practice in different parts of the country. School authorities should encourage it by allowing each school a small sum with which to pay transportation, and encourage teachers to go with their classes in school-time, as they do in Germany.

The Journal of Education publishes each week a list of valuable magazine articles on geography with a few words giving the gist of each article.

The constant use of the blackboard with colored crayons in teaching is one way to arouse attention.

Those who read Professor Dodge's "*Physical Geography*," will find it one of the best supplementary readers ever published. The strong points in the book are first its simplicity. Grammar school children in the upper classes can readily comprehend the subjects in the way the author treats them. In the second place the illustrations are telling; they illustrate the text and help the reader to understand the meaning of the descriptions, as all pictures should do. Very many of the half-tones are evidently made from photographs taken especially for the book and not picked up anywhere. In the next place the author has wisely made prominent human and other life conditions in so far as they are dependent upon or determined by the physical features of the world. These conditions are just what children can understand and enjoy. The work has been carefully and conscientiously done from the first to the last page. I suspect that adults as well as children will enjoy reading this book.

Put some question to the class each day for investigation. Be careful not to make it too hard.

Mr. Lyford of Worcester, Mass., hangs up before a window a frame of slides on some country and gives each child one picture to study. To help the children he gives them leaflets of information labelled and numbered to correspond with the slides. At some stated time the pupils report before the class the results of their investigations.

Children like to draw maps because it gives them something to do. Map drawing is both pleasant and profitable if printed outlines are used and not too much time is given to the subject, for maps are reproductions of facts learned previously.

China seems to be the attractive country at present. Ask your pupils to bring in every article they can find of value in reference to that country, and to be ready to tell you what it contains.

While geography by definitions alone is a perfect failure, it does not follow that no definitions or definite statements are ever to be learned.

Children in the sixth grade become deeply interested in learning to read a weather map. Some daily papers publish a very good weather map in their afternoon editions.

Why is your city, town or village situated where it is? K.

The Bed of the Pacific

The following interesting note appeared in a recent issue of the *New York Independent*. It will be profitable reading for every student in geography. "In considering the project for a Pacific cable, Congress will be assisted by an interesting report of the survey made by the Navy Department. A sketch of the first part of this survey was published last year, and now an account of the entire investigation is accessible. It appears that the surveyors on the ship "Nero" in their later explorations were able to measure the depth of the remarkable submarine abyss discovered by them last year on the route from the Midway islands to Guam. On the first voyage 4913 fathoms or 29478 feet of the sounding wire were unwound without reaching the bottom, and there was no more wire on the reel. The later exploration gave an actual depth of 5269 fathoms, or six miles, lacking only 66 feet. This is the lowest submarine depression yet discovered, and it has been named the Nero Deep. As a result of the prolonged inquiry, a practicable route for a cable has been found. The route from San Francisco to Honolulu was surveyed some years ago. From Honolulu to the Midway islands, it is an almost level plain of soft mud at a general depth of about 2700 fathoms; and the bed of the ocean from the Midway islands to Guam is for the most part level at a depth of about three thousand fathoms, altho it is marked in a few places by reefs and ranges of hills, one of these ranges rising to the southward and finally breaking thru the surface of the sea in the form of the Ladrone group of islands. The practicable route to Guam lies north of the Nero Deep, the southern limits of which have not been defined. Between Guam and the Philippines the bed of the ocean is less regular than to the eastward, but there is nothing to prevent the successful laying and working of a cable. On the route from Guam to Yokohama there was discovered a submarine mountain range, one peak of which rises to within 500 feet of the surface. Much difficulty was experienced in finding a suitable place for crossing this range. North of these mountains the bed slopes gradually eastward into the great Japanese Deep, which was for many years the lowest submarine depression known to explorers." J. P. G.

The Ozark Highlands

"Peneplains in the Ozark Highlands," by Oscar H. Hershey, in the "*American Geologist*" for January, is an article which not only contains much useful information for the teacher of Physical Geography, but at the same time furnishes an excellent type of a physiographic study. The Ozark highland is defined as comprising "all the mountain country of Arkansas, the eastern portion of the Indian Territory, and most of the hill-country of Missouri south of the Missouri river." It is divided into two parts by the Arkansas basin. The northern part corresponds in type to the Cumberland and Alleghany ridges and the Alleghany plateau of the Appalachians, while the southern division finds a counterpart in the Blue mountains east of the Alleghanies.

Five physiographic periods are distinguished. Following (1) the subaerial base-leveling of the Cretaceous strata, (2) an uplift took place over two-thirds of the region, ranging from 100 feet on the Missouri-Arkansas line to 1500 feet in west central Arkansas, after which the country was reduced to the Tertiary or "Tennesseean" peneplain. (3) A subsequent general uplift nowhere exceeding 300 feet exposed the region to a third base-leveling, which took place contemporaneously with the deposition of the Lafayette formation of the Mississippi coastal lowland. (4) Still another small uplift south of the Arkansas river gave rise to a system of narrow crooked valleys trenched beneath the Lafayette base-level, to which the name Ozarkian is applied, while (5) certain small canyons along streams tributary to the Arkansas, as Little Cedar creek northwest of Van Buren indicate a very recent uplift, which from the corroborative evidence furnished by the emergence of certain springs seems likely to be in progress at the present time. J. A. D.

REVIEWS

Physical Geography.—By William Morris Davis, Professor of Physical Geography in Harvard University, assisted by William Henry Snyder, Master in Science in Worcester Academy; 12 mo., cloth, 428 pages with 261 text illustrations and 9 maps. 1900. Price $1.25. Ginn & Co., Publishers, Boston and New York.

In recent years, much more importance has been given in colleges, high schools and universities to the study of physical than to that of political and commercial geography. It was the German geographer, Karl Ritter, who first pointed out, nearly a century ago, that a successful study of geography considered as the study of "the earth in relation to its inhabitants" must be based on physiography or physical geography, which Mr. Davis defines as "man's physical environment."

Prof. Davis' text-book is intended to describe and explain the principal physical features of the earth. His work forms a distinctly new and timely departure and a great improvement over many of the older text-books inasmuch as he not only describes but also explains all important features.

Since the earlier works of the American geographers Maury and Guyot, of the Germans Humboldt and Peschel, the English works of Huxley and Geikie, and of the French geographer Reclus, only a few thoroly modern text-books have appeared in America, such as those of Tarr and of Redway, and the monographs of Russell and Powell. Prof. Davis' new book forms a highly valuable addition to this literature, being not only up-to-date in every particular, but scientific, methodic, and yet elementary in character.

In one of his works on geography H. R. Mill pointed out the difficulties incident to a proper treatment of the subject of physical geography in so far as its material is less homogeneous, its limits less precisely defined, and also because it includes facts from a great many other departments of learning, some of which in the course of time have risen to the dignity of separate, tho correlated, sciences. For instance, in the study of the lands, the work of the geographer and that of the geologist go to a large extent hand in hand, yet the two start from different points of view. This difference was very happily defined by the geographer MacKinder, quoted by Prof. Davis, in the statement "Geology considers the past in the light of the present." Some matters relating largely to biological or bio-geography, and to anthropo-geography, must necessarily receive some mention in a book on physical geography. Chemical, optical and meteorological phenomena, as well as the great physical forces, must also be to some extent included.

While the school books on physical geography published in the last decade have made many great advances, particularly in the explanatory treatment of land forms, the book before us goes some steps farther in this direction than similar recent books on the subject. They all differ from the older text-books in that they include a large part of the valuable knowledge and of the numerous observations and facts which have been gathered during the past years, and which are the result of scientific exploring expeditions and of well-organized national topographic surveys, like the one of the U. S. Geological Survey, as well as others.

Thruout Prof. Davis' book, attention is drawn to the association of human conditions with the environment by which they have been determined. It is in this respect a thoro exponent of the "new method in geography", which considers the physical features of the earth as the guiding factors in the development of mankind as well as in the distribution of plants and animals.

The author divides the subject into four principal divisions; viz., the earth as a globe, the atmosphere, the oceans or hydrosphere, and the lands or lithosphere. Extraneous subjects are carefully excluded, and geometrical and astronomical considerations are given in a separate appendix.

The largest part of the work is naturally devoted to a study of the land and of the different landforms, for the reason that they are the seat of the highest forms of plant and animal life as well as the home of man. The many recent advances made in the study and explanation of landforms render it possible to adopt a scientific classification. The author's method of treatment of this subject is decidedly new, and he has illustrated it by a series of very clever original diagrams. First, ideal types are spoken of and explained, and then they are illustrated from actual examples of types, taken from American localities and also from Europe and other foreign countries. Here again the author tries to impress upon students the fact that all forms of the earth's surface have a history and a systematic development.

The descriptions are concise and clear, the language simple, the arrangement systematic. The pages contain many fine illustrations, some original, others taken from sources quoted, for instance from the valuable Gardner collection of photographs at Harvard University. The views of natural sceneries, such as that of an iceberg, of the ocean surf, of a high tide, of the Himalaya mountains, and others equally beautiful, serve to embellish the pages and greatly enhance the value of the book.

There are twelve principal chapters. The first one is a general introduction to the subject, and brief allusion is made to the many kinds of surroundings which man finds in different parts of the world.

In Chapter II the earth is considered as a globe and in its relation to the sun and other planets. The shape and size and the relation of the earth are briefly discussed in their bearing upon the following chapters.

Chapter III, entitled the Atmosphere, discusses the relation of man to climate, the effects of weather changes, the composition, temperature, pressure and circulation of the air, the causes of winds and of change of seasons, rainfall, and many climatic and meteorologic considerations influencing vegetation, and animal and human life. It also includes atmospheric electricity.

Chapter IV is devoted to the physical features of the ocean, its motions, the waves, ocean currents, tides, and the life in the ocean. This forms that part of hydrography recently denominated by the term oceanography.

Chapter V is entitled the Lands, and is a general introduction to the subsequent six chapters, which discuss the special types and features of landforms, such as plains and plateaux, mountains, volcanoes and earthquakes, rivers and valleys, drainage basins and river systems, shore lines and coasts, peninsulas and islands.

Special chapters consider the Waste of the Lands, and Climatic Control of Landforms. The appendix contains some discussions and problems pertaining to mathematical geography, an explanation of map projections, notes on terrestrial magnetism, explanations of weather maps, paragraphs on the moon and the tides, and also a very extensive bibliography for supplementary reading. Mention should here be made of the excellent reproduction of the relief map of the United States from the well-known Howell model; of the map giving the chief physical divisions of the United States with inset maps of Alaska and the New England states; and of the eight special outline maps of the various continents, printed in black and intended for reference in the study of the book. The entire make-up of the book reflects much credit upon its publishers.

W. P. G.

A Commercial Geography.—By John N. Tilden, author of "*A Grammar School Geography*". Revised and enlarged edition, 1900. Large octavo, cloth bound. Price $1.25. Thos. R. Shewell & Co., Publishers, Boston, New York, and Chicago.

This book is intended for American scholars. It is a thoroly up-to-date text-book, dealing with the production centres and markets of the world, and describing the increase of commerce, the growth of commercial cities, the routes of commerce and the principal means of transportation, such as waterways and railroads. The author aims to give to his readers some idea of the magnitude of the world's production, and to explain the interdependence of the earth's nations for both the necessities and the luxuries of life, and these objects he has thoroly accomplished. The book is full of important facts of practical value in business life as regards commerce and the interchange of commercial products. Besides these facts, it gives concise and accurate statements concerning the localities and countries which furnish the natural products or raw materials, concerning their interchange, home consumption and export, and the principal processes of manufacture.

The description of the physical and political aspects of countries is so arranged that they are placed in their relative order of importance as determined by their present commerce with the United States. The commerce and industries of our own country receive a much fuller treatment than those of other countries.

The chapter on the United States discusses area and position, physical regions, natural resources, population and occupations, raw products, manufactures, historic outline of the commerce of the United States, principal seaports, lake and river ports, other commercial cities and towns, and finally our territories (Alaska, Hawaii) and our new possessions, the Philippine Islands, Porto Rico, Tutuila, and Guam. Following the chapter on the United States, come several relating to the principal other commercial countries of the globe.

The introduction to the book contains a useful condensed review of mathematical, physical and political geography, followed by a general chapter on commerce and commercial highways.

The volume is made more valuable and attractive by the addition of several well-executed special maps,—one being a large reference chart of the world's resources, productions and trade; another illustrating the location of the principal canals of the United States and Canada; and another being a wind chart of the world. Special inset maps are given of four important canals and canal projects, namely of the Suez Canal, the Michigan or Sault Ste. Marie Canal, and the Panama and the Nicaraguan contemplated ship canals. There is also a chart, showing the chief mineral regions of the United States, besides several useful text illustrations.

Following each chapter, there is a full list of questions for review. Numerous foot notes, printed in smaller type, contain very valuable statistical information and interesting particulars, which are relegated to this place in order to condense the essential facts as much as possible.

After discussing the chief countries of the world and their commerce, the author deals with the commodities, dividing them into food substances, textile and mineral substances, metals, manufactured and other miscellaneous products. At the end of the book there is a very complete index.

The book has been thoroly revised and much care has been bestowed upon it in the endeavor to bring it up to date. Works of this character deserve a wide sale, and we have no doubt that the book before us will be largely introduced and used as a thoroly modern and up-to-date text-book in many progressive schools and colleges.
W. P. G.

Uncle Roberts' Geography.—By Francis W. Parker and Nellie L. Helm. A series of geographical readers for supplementary use. Three volumes, illustrated, 12 mo., cloth bound. Vol. 1, Play Time and Seed Time, price 32 cts. Vol. 2, On the Farm, price 42 cts. Vol. 3, Uncle Roberts' Visit, price 50 cts. D. Appleton & Co., Publishers, New York.

These volumes form a part of Appleton's well-known *Home Reading Book Series*, which is published under the general editorship of William T. Harris, United States Commissioner of Education. The aim of the new literary enterprise is the encouragement of systematic home reading. It is justly asserted that home reading furnishes the proper basis for extending the education beyond the school sphere: the habit of home reading for purposes of self-culture, once inculcated into a pupil, will in most cases become thereafter a habit of life. It must not be overlooked, however, that there is a right and a wrong way of acquiring knowledge from books. Any reading is bad which merely fills the mind of the child or scholar with a vast amount of dead matter or information which he is not able to apply advantageously; worst of all is that form of reading which merely commits to memory the contents of page after page without this matter being properly understood. Good books may, on the contrary, be read in such a way that the mind of the reader is incited to original observation, to further individual inquiry into the subject matter. Whenever this becomes the result of reading, it may be considered wholesome; and books which arouse the pupil's mind in the way indicated, may be considered healthful, good reading matter.

To such books belong the three little elementary primers named above. They are really nothing more than charmingly written descriptions of the many aspects of country life and of rural occupations. The key note for the books is found in the author's statement: "Fortunate are the children, whose early years are spent in the country in close contact with the boundless riches which Nature bestows."

The volumes cover a great many subjects and contain much interesting and accurate information. Their character and scope is thoroly elementary. The authors aim to teach children "to read aright the great book of Nature". The pages are full of vivid descriptions and interesting stories designed to arouse the children's imaginations, and to stimulate their powers of observation. In their simplicity lies, perhaps, the greatest charm of these little books. No one but a teacher in full sympathy with children, one who knows thoroly how to teach children, could write such books. For it requires many years of intimate contact with child life and child study to embody in a literary production the child's thoughts, his desires to observe Nature and life, his delight in acquiring knowledge by right methods of instruction. This the authors have thoroly accomplished and a wide appreciation should crown their efforts.

In the first volume, entitled "*Play Time and Seed Time*", the authors describe the romps of the children in the realm of Nature, their plays and games, their recognition of the year's seasons, the transitions of Nature from spring thru summer and autumn to winter.

The second volume "*On the Farm*" follows up these methods of investigation and deals with the interests of the children in the environment of a country home.

In the third volume, a beginning is made with introducing to the children in a popular form the study of earth, air and water, of plant, animal and human life. The most attractive chapter, possibly, is the one on the "big book of Nature", in which many things are touched upon which lie beyond the horizon of a child, and in which discoveries are indicated which have served to change mankind.

These inexpensive volumes are printed in clear and easily legible type on a good quality of paper, and interspersed between the pages are a number of superior illustrations pertaining to the subject matter. Other volumes in this series, dealing with rivers, winds, mountains, plains and deserts, and about our own continent, are in preparation. We cannot speak too highly of such helpful home-reading books, and recommend them to all teachers of elementary geography and natural history. W. P. G.

292636

EXCHANGE MATERIAL EXAMINED AND APPROVED

[Requests for information regarding the exchange of illustrative material should be sent to the Director of the Bureau, Winona, Minn.]

Model of Cape Cod.—Purchase price, $15.00. Prof. Vernon F. Marsters, Indiana University, Bloomington, Indiana.

The model includes Truro and Provincetown. Horizontal scale about 1.5 miles to the inch, vertical scale 600 feet to the inch. The model is of plaster, framed in oak, and is constructed by the contour method. The surface is colored, and the important features of drainage and the occupation of the land by man are indicated. Copies have been supplied to the geographical laboratories at Columbia and Cornell universities.

Forty Herbarium Specimens.—Purchase price, $2.00. Prof. J. A. Dresser, Richmond, P. Q , Canada.

Forty well mounted and labeled specimens of spring-blooming Canadian flowering plants. A properly prepared sample has been filed with the chairman of exchange committee. Minerals and plants desired in exchange.

Flax.—Purchase price, $1.00. Mr. Philip Emerson, Principal of Cobbet School, Lynn, Massachusetts.

Scutched flax (Russian, Dutch, Flemish, American), and dressed flax; and specimens showing changes from flax to linen thread and yarn. Thousand-word type-written description of process of manufacture, and bibliography of publications on flax and linen.

NEW MEMBERS OFFERING MATERIAL FOR EXCHANGE

(The list also includes recent renewals)

In the following list, a marginal * indicates ability and willingness to exchange photographs of neighboring geographic features, and a marginal † indicates the same for characteristic products. Those who offer to exchange both geographical views and characteristic products of their vicinity, are indicated by a marginal *†. Write directly to those members who live in regions from which photographs or specimens are desired; enclose stamp for reply; and, when making the exchange, aim to give rather more than you receive. To have material mentioned in detail as above, it is necessary to submit samples for examination. If approved, the material offered will be duly listed in the Bulletin; and a purchase price, representing cost of preparation, will be added for the benefit of those who have no material to send in exchange. The two detailed statements at the foot of this list show what a wealth of interesting material can be secured by those who take advantage of the department of exchanges.

CALIFORNIA

* H. W. Fairbanks, Geologist and Geographer, Berkeley.
† Alice A. Gates, San Rafael.
† F. W. Hooper, Principal of Etna Schools, Etna Mills.
* H. L. Lunt, Superintendent of City Schools, Riverside.
*† T. E. McCarty, County Superintendent of Schools, Placerville.
† Anne McLanahan, Supervisor of Grade Work, Bruceville.
* E. I. Miller, Teacher of Science, State Normal School, Chico.
† Mrs. Julia C. Sherwood, Spruce Grove District, Lower Lake.

CANADA

*† John Alexander Dresser, Principal of St. Francis College, Richmond, Province of Quebec.
† Arthur D. Fox, Tusket Wedge, Yarmouth Co., N. S.
*† O. E. LeRoy, Geology and Geography, McGill University, Montreal.
* H. J. Silver, 94 St. Urban street, Montreal.
*† William Ward, 131 Division street, Kingston, Ontario.

COLORADO

*† George Lyman Cannon, Instructor in Geology and Astronomy, East Denver High School, Denver.
*† Chas. V. Parker, Superintendent of City Schools, Trinidad.

FLORIDA

† C. L. Hayes, Principal of State Normal School, De Funiak Springs.

ILLINOIS

*† Mrs. Margaret S. Fitch, Principal of Prescott School, 1803 Barry Ave., Chicago.
*† F. W. Plapp, Jefferson High School, 2549 N. 42 avenue, Station 35, Chicago.
† Teachers Library, Board of Education Rooms, Joliet.

INDIANA

* W. J. Machwart, Professor of Science, Normal University, Muncie Normal City.

IOWA

* Arthur E. Bennett, Dean of Normal School of Upper Iowa University, Fayette.
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† John S. Roeseler, Principal of High School, 1404 N. Fifth street, Sheboygan.

WYOMING

* Frank H. H. Roberts, Principal of Normal Department, Laramie.

[The great variety of the material offered for exchange is partially shown by the following statements taken at random from scores of similar letters. Many of the members in the above list have even larger collections for exchange.]

Director, Bureau of Geography, Winona, Minn.,

DEAR SIR:—I can exchange the following material: 1. Sand from the dunes or coast; 2. Small bottles of sea water; 3. Tufts of moss two or three feet long; 4. "Pine Cones;" 5. Specimens of the "fat pine" rich in turpentine and rosin; 6. Oyster shells; 7. Other shells; 8. Fiddler crabs in preserving fluid; 9. Hermit crabs in preserving fluid; 10. Barnacles; 11. Sponges as nearly like they are when taken as I can get them and keep them; 12. Alligators stuffed and natural in appearance; 13. Alligator eggs blown out; 14. Coral of common varieties; 15. Live oak leaves pressed, and small pieces of the wood, and acorns; 16. Coquina, the building material of St. Augustine, such as is found in old Ft. Marion and the old city gates.

I would furnish everything in good condition and plainly labelled with explanations. Yours respectfully, C. L. HAYES.

State Normal School, DeFuniak Springs, Fla.

Director, Amer. Bureau of Geography, Winona, Minn.,

DEAR SIR:—Here is a list of specimens I can exchange: 1. Gypsum (satin spar, white granulated, gray foliated); 2. Actinolite; 3. Calcite (large cube crystals, small massive crystals, common limestone); 4. Quartz (rose, flint arrow heads, etc.); 5. Orthoclase; 6. Spodumene; 7. Garnet; 8. Amphibole (black, bladed); 9. Agate; 10. Zircon; 11. Bauxite; 12. Kaolinite; 13. Siderite; 14. Turgite; 15. Pyrite; 16. Cassiterite; 17. Petrified moss.

I also have about 600 specimens of plants that grow in this locality. Among them is the rare orchid, Epipactis viridiflora. I would gladly exchange these also. Respectfully yours, C. C. ALBRIGHT.

Rapids, N. Y.

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AIMS OF GEOGRAPHIC INSTRUCTION

BY HENRY McCORMICK, STATE NORMAL UNIVERSITY, NORMAL, ILL.

In teaching any subject the teacher should have a definite purpose in mind, as it is only when he does have that he can work intelligently and effectively. Without such a purpose he is groping in the dark, and in danger of getting lost in the slough of uncertainty. He may direct the energies of his pupils in the right direction, or he may not; it is "hit or miss" with him, and more frequently miss than hit.

Not only should there be a purpose in teaching the subject as a whole, but each term's work, yes even each lesson should be taught for the realization of some attainable and praiseworthy end. A lesson that does not leave the pupils better and stronger than they were at the beginning of the recitation must have been poorly taught. It needs no argument, however, to prove that there are many such lessons, and that they are due to the vagueness of the teaching. And the vagueness, itself, is due in many instances to the fact that the teacher's main purpose seems to be to get thru with the lesson in the allotted time. No doubt it is well to complete the lesson, but it is not completed, unless there is a positive gain in knowledge and in mental power. Educational completeness does not consist in the reciting of paragraphs, pages, or chapters, but in the mastery of truths hitherto unknown to the learners and in the conscious strength that results from such mastery. These should be the aims in all teaching. All others are of secondary importance; these are vital.

Definiteness of purpose is especially necessary in teaching geography. The field of geographic study is so wide, and contains so much that is interesting that unless the teacher has a definite aim in view, there is danger that his work will be too scattering and disconnected to be effective. The interest inherent in the subject makes the danger all the greater. Some subjects have a narrow range. The line of procedure is so clearly marked that the teacher finds no difficulty in following it. It is not so with geography. Here he may know the subject matter fairly well, and may know something of the laws of mental growth, and yet fail to accomplish the proper purpose of his teaching.

In order to make the best use of his knowledge, the teacher must be able to see the entire course in geography, from beginning to end, spread out before his mental vision. His grasp of the subject must be so clear and strong that were all courses in geography blotted out of existence, he could make a satisfactory one for his school. This should not be considered as demanding too much. If he knows the content of the subject and the purpose which it is intended to serve, he will not find the making of a course a heavy burden. It is quite certain that if his knowledge is not thus clear and full, his aim in teaching will be obscure, or at best it will be guided by some other person's "sight."

It goes without saying that what has been said of the entire course in geography is equally true of a year's work, a term's work, or an hour's work; and ignorance of these smaller units is less excusable than is that of the larger one. In reality there is no valid excuse for ignorance or neglect of either. Excuses, at best, are poor substitutes for the faithful discharge of duty. But while a wise adjustment of the topics for these smaller divisions of the work is commendable, the greatest benefit comes only from seeing the proper sequence thruout the entire course. Inability to do this causes chasms between the work of the different grades; and there should be no chasms, as the work to be most effective must be a continuous and well-related whole thru all the grades

The value of any subject of instruction may be judged from two points of view, its efficiency in promoting mental growth and the character of its content. The two are so closely related, however, that it is difficult to separate them, and it may not be wise to atttempt to do so. The acquiring of knowledge causes the mind to grow, and it is only as the mind grows that knowledge is acquired. Still it will do no harm to say that the acquisition of knowledge and the growth of mental power are the marks at which the teacher should be aiming constantly. Geography is a valuable instrument in promoting both of those purposes. It deals with the earth as the home of man, and the theatre of all his activities. It regards the sustenance and education of man—physically, intellectually, and spiritually—as the ends of creation, the purposes for which the earth was called into being. It shows that the earth furnishes man with food, clothing, and shelter; that it presents problems for solution which taxes his intellectual powers and calls for the putting forth of his best efforts; and that it holds out the strongest stimuli for human action. To the superficial observer it may seem that the earth contributes only to man's physical wants. It does more than this however; but even if this were all, it would still be worth careful study. Mind without body, if such were possible, would be of little consequence. The body is the instrument by which the mind is built up, and thru which it works; hence the need of its being in the best possible condition. In order that it may be in this condition it must have food, and this the earth furnishes in abundance.

It has been said that clothes make the man, and the saying has in it a large element of truth. Before he began to wear clothes man amounted to but little. And down thru the ages his condition at any point in his career is indicated by the character of his clothing. The earth is the wardrobe from which he must obtain his supplies, be he prince or beggar.

While man lived in a cave there was little intellectual progress. The cave answered as a shelter for the time being, but in order to advance he had to build his shelter. To enable him to do so the earth provided stately forests, massive quarries, and clay in abundance. It also provided the materials with which to furnish and adorn his home; and the variety of materials kept pace with his desire and ability to use them.

Food, raiment, and shelter were thus furnished him as he felt their need and could appreciate their convenience. This fact should be taught to the children; but the teacher who stops with the bare recital of the fact is not making the best use of his opportunity. How was the forest converted into houses? To answer this question the pupils must, in imagination, go with the teacher into the lumbering camp and see the trees felled, cut into the desired lengths, hauled to the stream, and floated down to the sawmill where they are fashioned into timbers, boards, shingles, etc. From the sawmill they should go to the planing mill and factory, and see the operations carried on in each. Let them see how the lumber is transported from Minnesota, Wisconsin, or Michigan to the prairies of Iowa and Illinois and there erected into comfortable homes.

Nails and other articles of iron or steel are necessary in building, how are they obtained? To answer intelligently the children must visit an iron mine and see how the ore is procured, follow it to the blast furnace where it is mixed with the product of the coke oven, etc., and comes out a fiery river which is diverted into many little channels where it cools and becomes pig iron. From there to the converting works where it is changed into steel, and then to the factory where it is made into the desired articles will be an instructive journey.

Glass also is necessary. Let the children see the various steps in its manufacture from the time the sand is taken from the earth until it is made into the various kinds of glass used in building. It is well enough for them to know that glass is made from certain kinds of sand mixed with other substances, but to know how it is made has a higher educational value.

And so with their clothing. How is the flax of Iowa, Minnesota, and Canada converted into linen, the wool of California, Montana, Ohio, and Vermont into warm, winter clothing, or the cotton of the Southern States into garments more suitable for summer. The children should be helped to see with the mind's eye a field of cotton under cultivation, to see how it looks before the bolls burst open, and after, when it appears in its snowy whiteness. They should help in its picking and in taking it to the cotton gin where the seed is separated from the fiber. Then assist in baling it, and follow it to the factory and witness the processes by which it is made into cloth.

Agriculture, which is the foundation of all arts, should be taught in connection with geography. It is not meant by this that all the details of farming should be entered into as in an agricultural college, but that the general operations carried on, on the farm should be made familiar to the pupils. Now it is customary to teach that this State or that is well suited for farming, and that it produces large crops of corn, wheat, oats, etc., but how much will such a meager statement mean to boys and girls who live in the city and have seen but little of the rural regions? They may get as much out of it as the country-bred children will out of the equally luminous declaration that cotton, flax, and wool are made into cloth, trees into lumber, and iron into many useful articles—and that is but little. To get the greatest value from the study, the children must be taken into the country, in imagination if not in reality. They must see how the ground is prepared and the corn planted. They must watch the farmer, day by day, as he cultivates it, or else they may think that in order to get a large crop all he has to do is to plant the seed. They should learn the purpose of the silk and tassel. They should take part in husking the corn and in hauling it to the crib, and, later on, in feeding it to the stock. Or if the farmer does not make stock-raising a business, let them assist him in getting it to market. They should also learn how it is made into many kinds of wholesome food, some of which they had for breakfast, perhaps. The other grains, principal vegetables, and fruits should be treated in the same manner. Such study is invigorating and full of interest, especially of human interest, as it deals with the greatest needs of humanity, their own needs, instead of juggling with the names of insignificant places and things which touch their lives in no manner whatever. It will call into play other powers of the mind besides memory. Perception, imagination, and judgment will be exercised at every turn, and there will be a symmetrical mental growth.

This manner of treatment will lead naturally to the teaching of mining, manufactures, and commerce, and this is very desirable. There is no sense in teaching them as isolated subjects, and they cannot be so taught to advantage. The earth is the stage on which man carries on all his operations and agriculture is the basis of all the others. They grow out of it, and without it they could not exist. It is what makes the earth a fit home for man. And yet, notwithstanding its importance, it receives but scant treatment from the average text-book on geography. This is wrong; but the teacher can remedy the wrong by making it one of his principal aims to teach the conditions of the earth that make agriculture possible and profitable, and the dependence of the other activities upon it. He will not find this a difficult task. The children can readily be made to see that when the crops fail, mining, commerce, and manufactures languish. People stop building railroads, digging canals, and building ships, as they have no use for them. Warehouses go to ruin, the merchant goes into bankruptcy, and grass grows in the streets of the city. When the pupils know why these sad results come to pass, they will probably look with more respect upon the farmer, whose labor, notwithstanding his coarse clothes and rough hands, is so essential to the welfare of society. Not only so but they will be able to appreciate the importance of labor in general, whether carried on in the mine, in the factory, or in the transportation of the various products. The laboring man instead of being looked upon with disdain will be justly regarded as an honorable member of the community, and the children will realize their indebtedness to him.

Geography is thus the unifying subject of the various industries carried on by man. It is also the key to the proper understanding of those sciences which do most in assisting him to master his environments. Many of the problems with which chemistry and physics busy themselves are earth-born. History should rest upon the earth instead of hanging in the air, as it often does. Botany and zoölogy find their interpretation in geography; while geology is its sister united with it by physiography which partakes of the nature of both. Consequently the relation of these subjects to geography should be clearly set forth, as unification of knowledge should be one of the aims of geographical study.

If the above statements are correct, and it is believed they are, it follows that one of the aims of geographic instruction should be to enable the pupils to understand their relation to the earth, and the processes by which it was prepared to be so helpful to them. The surface of the land did not always have such a pleasing variety of forms as at present. The agencies by which it was fashioned into mountains and valleys, rounded hills, and broad plains are still at work, and most of them can be studied in nearly every neighborhood. The manner in which the rocky ledges of the mountains have been worn away, transported to lower levels, and changed into soil fitted to bring forth food for man and beast will not be neglected by the thoughtful teacher. And in teaching those things he will not substitute the knowledge acquired from books for that which may be gained by seeing the forces of nature themselves at work preparing his home for man. Under his tuition books will be freely used, but they will be used to supplement nature, not to supplant it, as he knows that He who created the earth also endowed the mind with its possibilities and has adapted the one to the needs of the other. Consequently he will not build up a barrier of books between them.

Geography should also teach that the oceans, which were formerly regarded as separating the great bodies of land, in reality connect them. For a long time the chief functions ascribed to them were the wearing away of the land in some places, the building of it up in others, and the furnishing of a bountiful supply of moisture. To these is now added another; they have become the commerce bearers of the nations. In this capacity they make possible a large increase in the sum of human happiness and comfort by so facilitating an exchange of the products of different parts of the world that even the man of the frozen regions may be nourished by the foods of the temperate zones and regaled on the fruits of the tropics. And the mutual exchange of relations thus established tends to promote a higher civilization, and to beget a spirit of brotherhood which mitigates many of the hardships which fall to the lot of man.

The atmosphere, too, will receive due consideration from the thoughtful teacher of geography. And he will not put off the subject until his pupils reach the high school, as he is well aware that but few of them will ever reach that goal. It is the mediator between land and water. Without it no refreshing showers would ever reach the land. There would be no rivers or lakes; and the rugged mountains would not be converted into fertile plains. Life of any kind would be impossible, and the land would be a dreary waste. The atmosphere, under the influence of the sun, not only acts as water-carrier but it continues its beneficent work by equalizing the temperature of remote regions. It mingles the oppressive heat of the tropics with the benumbing cold of higher latitudes, adding much to the comfort of life in both. And not satisfied with this it busies itself in sanitation, carrying off the germs of disease and death which hang over the plague-stricken city. While its value as a mechanical agent cannot easily be over-estimated.

Geographic instruction while presenting the earth as the scene of man's activities, the storehouse from which he draws his supplies, and the instrument for his education, should not neglect the sun which is the source of all life and energy upon the earth. It changes the water of the ocean to vapor, and calls up the winds to carry the life-giving fluid to the thirsty land. Its genial warmth penetrates the ground and endows the dormant seed-germs with power to burst thru their shell. As soon as the tiny plants appear, the sun takes them under its protection, and carefully nourishes them from day to day. It clothes the hills with trees, the valleys with grass, and the plains with flowers, that man's abode may be worthy of its occupant. It regulates seed-time and harvest, and crowns the labor of the husbandman with plenty, or blasts his hopes with empty barns and lean granaries. Yet great as the sun is and mighty as is its power, as shown in making the earth fruitful and in controlling the movements of the planets, the children can be made to see that the highest purpose of its existence is to minister to man's happiness and well-being. For this all things were made, sun, moon, earth, and stars. Without man they would be meaningless; with him as the central thought they are highly significant. Man is the noblest of God's creation, but he draws his strength from the earth. Consequently any geographic instruction that fails to trace the mutual relation of the earth and man, and to witness their action and reaction upon each other, falls short of its duty.

As a result of this action and reaction man soon learned that he had wants which his natural environments did not satisfy, so he used these to create artificial environments suited to his needs. He built cities, ships, railroads, canals, telegraph lines, etc., and thereby enlarged his field of operations. The pupils know that these are contributing more and more to man's physical wants and comforts, as the years go by, and are affording opportunities for a higher intellectual culture. And they will readily see that these artificial environments promote a larger and more wholesome social life. Man is a social being and desires to associate with his fellows, and the inter-dependence of the city and country fosters this desire. The country furnishes the raw materials, but the city converts these into usable articles and in doing so largely increases their value. This increase is due to labor and skill, but the skill can be acquired only at industrial centers where many persons compete for supremacy in their different vocations. And while it is true that agriculture is the foundation of all industries, it is equally true that it is made more profitable by the labor of the manufacturer, miner, merchant, etc. The pupils will learn that all who are engaged in any honest employment are useful members of society, and that the efforts put forth in any one calling can realize the best results only by being aided and supplemented by the efforts put forth in all others. Thus they will note the dependence of each upon all and of all upon each, and the lessons in geography will become lessons in sociology and lead to a better understanding of the social fabric.

If these lessons are properly taught they will show that to be most helpful and enduring the social relations of both individuals and nations must rest on the principles of justice, truthfulness, and mutual forbearance. Capital and labor are both essential, and each has rights which the other should respect; but neither has the right to advance its own interests at the expense of the other. Employer and employé are both useful members of society; but when either takes undue advantage of the necessities of the other, he inflicts the greater injury upon himself, as he impoverishes his manhood. The seller and buyer fill important places in the social order; but when either tries to over-reach the other in a bargain, his real usefulness to society is impaired and his soul is shriveled by the transaction. It is within the province of geography to teach these things. The study of the different industries, such as commerce, mining, manufacturing, etc., afford ample opportunities, and they should be improved.

SOME MENTAL PROCESSES IN GETTING AND USING GEOGRAPHICAL NOTIONS

BY F. L. CALKINS, SUPERINTENDENT OF SCHOOLS, DELAVAN, ILL.

Expression is too often thought of as the finished product. For ever so little expression there must be ever so much thinking, and considered as an intellectual machine, "As a man thinketh, so is he." The product implies factors and *processes*. It is never safe to estimate 'cost' by 'product' alone. From the raw material *all*, including waste and by-products, must be taken into account. "What is worth doing is worth doing well" has a profound meaning for every teaching act. The process is more than the visible product.

The better part of what follows will not be well understood (whatever its value) unless the reader keeps in mind the fact that every mental act is at the best complex. It must be remembered that much is present in the mind, in the evolution of the thought, not prominent in consciousness. As is evidenced in dreams, mind and consciousness are not the same thing. The relative degree with which a part of a mental process is present in consciousness does not by any means indicate its relative importance. As the tree's strength and increase come from hidden parts and hidden influences, so the growth, strength, and quality of mental increase and power have origin in the sub-consciousness and deeper.

Inattention to these conditions or a misconception of their meaning and importance leads to much poor teaching and to much more poor thinking, and often, if not necessarily, to half-truths and error. The deeper into the mental processes the instructor can see, the more helpful he becomes. The more clearly the student sees the inner workings of his own mind, the notions supplementary to the principal thoughts, the better the fiber of his mental growth. As various instruments having different timber may produce the same tone, so many minds may come to like conclusions by various routes.

The several subjects in any course of study have various educational values as they make possible a variety of mental exercises. This variety of material stimulating the activities of a class, large or small, will give rise to an almost infinite possibility of mental processes.

Every division of the school work is a source of difficulties to be sought out and avoided. An illustration from elementary number work will be in point. A class of twenty pupils are asked to add twenty-seven and eight, and all solve the problem correctly; but investigation may show six or eight distinctly different processes and many "vain visions." But one of these routes is the shortest, and in this oft recurring problem the shortest is the best.

Remembering that what we are after lies much below the surface, let us turn our inquiries in the direction of the "solution" of problems in geography. We shall neither exaggerate the conditions nor do harm to our judgment to imagine the following dialogue: Teacher of geography to primary class, "In what direction from us is Iowa?" The class answer, tho not in concert, "West." The teacher unveils the following "solutions:"

First pupil, with appropriate gesture, "I saw the map."

Second pupil, "I saw the globe."

Third pupil, "I remembered the answer."

Fourth pupil, "I just thought that Iowa is *this* way." (Looks and points west.)

Teacher, "Yes, Iowa is west of us. This way just beyond the Mississippi river. But when you think 'Iowa' does it always *seem* west?"

Fourth pupil, "Yes." Others, "I do not know."

One pupil admits that "It always seems to me to be down here on my left," etc., etc.

The writer's contention is that what this teacher found is a type of the universal. The confusion of thought here but briefly indicated is by no means confined to primary pupils in school, nor is it confined to the schoolroom at all. This unfortunate confusion of the real and the intuitive seeming is found everywhere, deep-seated and evasive, in the busy business and social world. Too many of us have so been taught and have so studied that we may by some process *reason* for the conclusion that Iowa is west, yet do what we may to rid ourselves of the delusion, obtrusive and costly, "Iowa *seems to be* down here on the left." It will not do to hastily conclude that such conditions are the exception and are to be found only in the minds of children or the uninformed. In answer to close questioning, the writer has seldom or never failed to find, in the inner thinking of the brightest and best, very peculiar, perplexing and often quite abnormal images and combinations of images. In a fourth grade when under a rapid fire of questions as to the direction of much talked of places, one of the brightest was heard to be reasoning in an undertone, "North is east." The bright little woman in charge of the class, noted the remark, the puzzled look and fruitless gesture, found the cause and the remedy. Another grade pupil says, "South America always seems to be here over my left shoulder." A high school senior says that to locate any part of the Old World, he must take his point of view in the Indian Ocean. Another says that England seems nearer than Ireland, and London nearer than Liverpool. A Sunday School class of young ladies had just read the sentence, "At sunset he stood [in Palestine] looking far out upon the Mediterranean Sea." The class divided on the question, "Was the man looking toward or from the sun?" It took some time to bring all into agreement and but one or two made any *proper* effort to see things (mentally) *as they are.* A city superintendent past middle age, an educational leader, says: "To locate places in the United States, I must bring the map from the left to the front and turn it around." Another superintendent says, "I always see Africa upside down, the Nile on the left, the Congo on the right."

These illustrations are selected at random. They are by no means isolated cases. The average mind—often the best mind seemingly—is full of like anomalies. Nor can we pass the matter as an interesting peculiarity of no very great moment. On the contrary it is of the greatest importance that these conditions do not exist. They are not necessary. They block progress. They supplant what is of infinitely greater value.

Before proceeding further, let us ask once more, What is geography? If we consult the best authorities we shall find many helpful definitions, differing widely. If we look at the thing itself (the wiser plan) no two of us will precisely agree. Is geography a composite study with inherent, intrinsic fundamentals, having essential coördination and logical sequence? Or is it a conglomerate, a medley, to be come at backwards as profitably as forwards? Certainly not the latter. If the former, what are the fundamentals? What is proper coördination? What is the logical sequence?

I wish to give a partial answer to the first query. There is something of botany, zoölogy, astronomy, physics, etc., etc., in geography, and necessarily so. We shall never find geography, however, by this process of addition; rather let us subtract. Take from geography, so-called, botany, sociology, etc., etc., and ask whether anything remains. We shall all agree that the very essentials still remain. Every notion of pure geography has in it direction, distance and magnitude. • History and the study of geography are so intimately interwoven that in very many notions the time element is highly essential. Reversing the reasoning, if from geography, as rightly defined, we take direction, distance, magnitude, and time, no geography proper remains.

Because of vague comprehensions of the spirit of true geography and its relation to knowledge in general, and to the pupils' needs subjective (a means to an end) as well as objective, much of our teaching has been contrary to human instincts and reason. The culture or disciplinary value has been of doubtful quantity and quality. Often the child mind and life actually demand what we either neglect or actually forbid. Note the eager longing to get *out*, even in imagination; to analyze; to construct; to ask whence? whither? and why? These desires are instinctive, not born of the weariness of the school routine. This is *Nature* asserting herself, claiming her own. Respecting natural tendencies so constantly neglected, the following test will be food for profitable reflection.

Purposely omitting definite location, give the class general notions respecting Niagara Falls. Tell of its beauty, power, etc. Repeat this from time to time with additions. Now call any member of your class to your desk, and ask him to place the pointer indicating the direction of Niagara Falls. In like manner test the entire class. Record results not purely imitative, and note: first, that a large majority have placed the pointer with *little* or *no hesitation*; second, there was a variety of opinion, practically no agreement; and third, that tho in many cases the difference was slight, yet it was a *positive* difference. Repeat the experiment another day, and note fourth, that the results first and last will coincide with remarkable precision.

The meaning of this is evident. If when you attempt to give the child, "Niagara Falls," "Indianapolis," "Virginia," or "Sunny

France," you fail to show him, painstakingly, where to put it, in his mind, and out of doors, and out of books, and out of maps, as it really is in fact, he will of necessity, according to his interest put it *somewhere*, quite definitely and fixed and related. If left to *chance* he will more than likely be wrong; and so will be, not only this fact, but all those that follow, coördinate or super-related.

Very much of location is not to be learned from map or book, and no fact of location is to be so recited finally. To this end all must be, so far as possible, *experienced*, *seen* and *felt*. This part of the subject must become truly a part of the student. This new fact must be so acquired and related as to be one more decided step forward. Out of chaos into nearer and clearer relation with the world of which he is physically and mentally a living and moving part. Niagara is never taught till so taught and then only has it become a thing of beauty, joy, or profit to the mind.

There is great danger of bringing the pupil too soon to his map making and map study. In the elementary steps of geography getting, he has no desire for a map. He has no use for the map. He has not the ability to rightly comprehend its meaning. Custom overrules our judgment here, and we allow the map to take the place of something infinitely better. At the best maps are likely to be a source of error, especially those made by children. It is unfortunate, if unavoidable, that the "top is always north;" that the round earth must be represented on a flat surface; that so many scales for construction must be in the same course, room, or text; that the homemade clay relief map must be in vogue, when we know that the shopmade relief maps teach more error than truth. Painted or printed relief maps, on the contrary, are, in the hands of a thoughtful teacher, valuable, as also are bird's eye views and vertical section drawings.

Maps to be rightly effective must be treated constantly as *tools to an end* only; as tools to help us to do that which we could not do without; as aids to an end, having reached which the maps themselves may be discarded, as would be a ladder which has helped us to the highest plane, and now become a burden and no longer an aid. Map facts are comparatively valueless—world facts only are the ends to be sought, aided if need be by the maps. The writer would never permit a pupil to get a fact or notion from or by means of a map that could be obtained in any other way. And seeking to know some other way will cure many a fault in our present methods. By repeated effort on the part of the teacher and pupil the *new* fact must be rightly related to what the pupil already knows, and feels, and is.

It has been thought a harmful necessity that the pupil passing thro the grades must sit facing now east, now west, etc., or that he must sit in a room not "square with the world." Rather than harmful, this is precisely what should happen, provided always the teacher sets the pupil, so to speak, "square with the world." Many pupils, even in their home school, are "turned around." Since location may like other objects of study be "bookish" and pass for attainment if recited as "in the book," yet it is always painfully evident that thoughtlessness on the teacher's part makes every other effort on his part futile and very likely negative. Here more than in any other study, first impressions are lasting. First geographical notions are fundamental and essential to very much that is to follow. These first notions of location are in the subconsciousness, and determine the tone and strength of the superrelated.

Geography is pre-eminently an *outdoor* study. It *must* be so taught. The child must be made to image things, *as they are*, and *where they are.* To this end pictures in abundance, good maps rightly used by pupil and teacher, illustrated descriptions properly read are within the reach of all and indispensable. Yet it must be admitted that the *oral* work of the teacher, stimulating the imagination of the pupil with proper gesture, is the factor determining more than all else the permanent value of the study.

The importance of the rightly laid foundations of geography work, subjective, can only be truly estimated by those who see the truth that to nearly all branches of school work, geography is so vitally associated as to be of each branch the supplement. When we know Martel we must know France. Then we may more readily know Napoleon. To do either we need not go to France, nor fetch France to us; but rather sit in our own home, conscious of its location, and see France, here, toward the rising sun, see its location—in place and time. Each effort of this kind, not only in geography but in literature, history, etc., will make France more real and more enjoyable. What is France? and Where is France? are questions never to be separated. As the soil of France was necessary for the movement of Napoleon's cannon, so a right substratum of location, subjection and intuition in the mind of the learner, is essential to what he must know of the history, literature, philosophy, and arts of this one part of the world of which he, too, is a part.

Paradise Lost could never have been written in New York. The Biglow Papers are one of our "natural products," mountains and poetry, rivers and religion, are all interrelated and interdependent. As in Shakespeare's masterpiece, Cordelia, tho reciting a scant one hundred lines, gives color and tone to the entire production, so the elementary, deepseated geography notions give life, character and value to all that is superrelated. As these fundamental concepts are false or true, indistinct or clear, rational or abnormal, so to a very great degree, must be the superstructure.

TRAVEL AS AN AID TO THE GEOGRAPHY TEACHER*

BY EDWIN STANLEY THOMPSON, MT. AIRY, PHILADELPHIA

I can easily remember the day that I began the study of geography. Warren's "Geographical Question Book"—a thin 12mo volume of questions and answers—was put into my hands and I proceeded to memorize it like the Catechism.

What is the earth?

The earth is a large, round body composed of land and water.

How much of the surface of the earth is land?

One-fourth of the surface of the earth is land.

How much is water?

Three-fourths.

I quote from memory, but I think I am not far from the exact words.

I also remember how, in the presence of visitors, I was the only member of the class who could illustrate the relative proportions of land and water by a blackboard sketch. This I did by drawing a circle and dividing it like a pie into quarters, placing a W on three of them and an L on one. Simple as this incident may appear I now look back to it as a sure indication that I was thus early intended to be a teacher of geography.

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*This article appears also in the June number of the Association Review, the organ of The American Association to Promote the Teaching of Speech to the Deaf, published at Mount Airy, Philadelphia, Pennsylvania.

After having learned the natural divisions of land and water with their definitions, we soon came to "Bound Maine."

Then with the aid of a large quarto book of maps, we learned to locate and describe hundreds of mountains, lakes, bays, islands, cities, etc., and to learn from the Question Book the products of states and countries that have now all escaped me except the "cheese, cork and marble" of Greece.

I have a kind of vague feeling that once or twice during my school course some object of interest was shown me in connection with my geography lessons, but it must have been so very irregular that no stress was laid upon the article and no deep impression made. The relation between the life of man and the land upon which he lives, was never pointed out, and it was not until I began to teach Frye's and Redway's books that I began to appreciate the real beauties of geography. I began to realize that boundaries, minute coast indentations, and alternations of rivers, now to the southeast, and now to the southwest, upon which so much stress was laid in my education, are nothing in comparison with the great laws of slopes and rainfall and the direction of winds. It is not enough to know that there is a river or a city or a desert in a given place. Why is the city there and not the desert?

But interesting and valuable as these laws are, they do not completely satisfy my ideal of what geography teaching should do. To me the earth is the home of man, and he should receive as much attention as the land and water. Whatever will give clear ideas of man's mode of life in the different parts of the world are the legitimate materials of geography teaching. These materials may be collected at home or they may be the souvenirs of travel in the various countries. I employ both methods, but prefer the latter as it gives more life and interest to an object if I can tell my classes the very circumstances under which it was acquired. During the past five years I have traveled somewhat extensively in America and Europe and have gathered quite a collection of inexpensive articles that I am constantly using in my teaching.

There are four things that I have brought from every country visited, viz., the flag of the country; a set of the coins in common use; a newspaper, to illustrate the language; and a postage stamp that will bring a letter from that country to the United States.

The flags in a uniform set, I might have purchased at any department store in this country, but I value far more the fourteen odd-shaped ones that I purchased each in its own country, some of silk, some of printed cotton and others of sewed bunting. Each one recalls the incidents that accompanied its purchase. That printed Norwegian flag from Molde was cut from a strip containing many of its kind, and hemmed, at my request, by a pleasant woman on a hand sewing-machine. That Italian tricolor was made especially for me by the wife of my gondolier at Venice. That Dutch tricolor, intended as a part of the decoration in honor of the young Queen's inauguration was purchased in the people's market at Amsterdam. So each has its history.

The newspapers range from a tiny four page sheet, "Dagskra" from Iceland through all the common sizes to a kind of Russian "Puck," whose colored pictures illustrate what are probably side-splitting jokes if we could only read them.

The stamps are compared with our own five-cent stamp that will carry a letter to most foreign countries.

The coins include the unit—as the franc, the krone, the ruble—and its subdivisions, except the English collection, which includes every coin from the sovereign down to the farthing. These are compared in size and value with the coins of our own country.

Besides these four regular souvenirs I also pick up some little things that are typical of each country, as a small model of the wayside crucifix from the Tyrol, an icon from Russia, a handful of reindeer moss from Norway. None of these things are costly but they illustrate and make real the lessons.

The value of pictures in geography teaching is too well known to need any argument. These, like other illustrative material, may be purchased or they may be the teacher's own work. The latter may not be so artistic but they show the places just as they were seen. Then, too, the teacher knows what he wants and chooses his point of view accordingly. I should not feel natural if I were to start on a journey without the strap of my camera-case over my shoulder.

A small expenditure of time and money will convert one's travel-pictures into lantern slides and their value will be more than the hours and dollars that they cost. I know of no way that a camera may be made to give pleasure to so many people as when used in connection with the magic lantern. In my own work with the deaf, the explanation can not be given while the picture is on the screen, so I write upon glass brief descriptions which are shown on the screen just before each picture. After many experiments I have found that a lithographer's pencil is best for this writing. It may also be used for drawing maps and diagrams.

Besides furnishing the teacher with objects and pictures and anecdotes with which to brighten the brief accounts of the textbook, travel also enables him to detect errors in the so-called supplementary readers that are often compiled by those who have never seen the places described.

Many teachers say that they can not afford to travel. I claim that a teacher of geography can not afford not to travel. It increases his efficiency; and for the pupils there can be no substitute for personal experiences quite equal to the experiences of a traveled teacher.

STANDARD AND LOCAL TIME

BY WILLIS E. JOHNSON, STATE NORMAL SCHOOL, MAYVILLE, N. D.

Properly to understand the subject, one must constantly bear in mind the simple relation of difference in longitude to difference in time. Since on the average the sun apparently swings once around the earth in twenty-four hours, its rays will sweep over fifteen degrees in an hour or at the rate of four minutes for every degree. Students are sometimes confused as to the time of day in places east of a given meridian as compared with the time in places west of it. When the sun is rising here, it has already risen for places east of us, hence their time is after sunrise or later than ours. At the same moment the sun has not yet risen for places west of us, so their time is before sunrise or earlier than ours. When it is noon by the sun in Chicago, the shadow north, it is past noon by the sun in Detroit and other places eastward and before noon by the sun in Minneapolis and other places westward. These facts, which are readily ascertained by telegraphic communication, constitute excellent proofs of the curvature of the earth. Were the earth a plane, the rays of the sun, from its immense distance, to places relatively near together, as Philadelphia, St. Louis and Denver, would be almost exactly parallel. The solar time at these cities would then be the same.

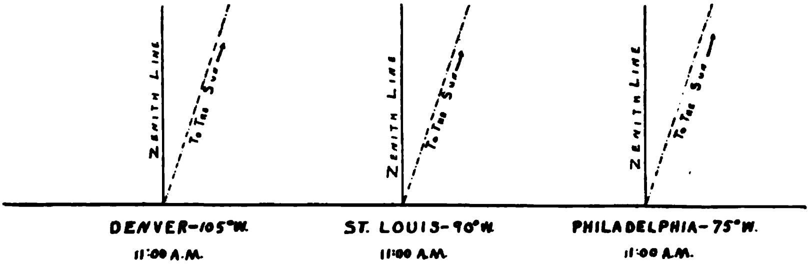


FIG. 1. IF THE EARTH'S SURFACE WERE A PLANE, SOLAR TIME WOULD BE THE SAME EVERYWHERE.

Owing to the curvature of the earth when it is 11:00 o'clock at Philadelphia, it is 10:00 o'clock at St. Louis and 9:00 o'clock at Denver.

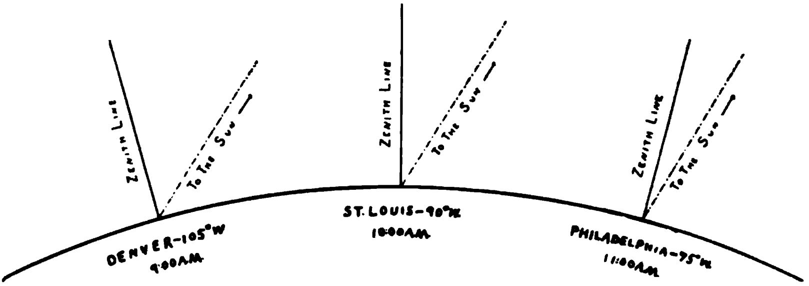


FIG. 2. CURVATURE OF THE EARTH'S SURFACE CAUSES DIFFERENCES IN SOLAR TIME.

A man when in London set his watch according to mean sun time there. When he arrived at home, he found the mean sun time to be six hours slower than his watch. It is obvious that he must have travelled westward 90°.

While on shipboard at a certain place, he noticed the sun's shadow was due north when his watch indicated 2:30 P. M. Assuming that both the sun and the watch were on time, his longitude then was 37° 30′ west from Greenwich. It may be well to note in this connection that when navigators ascertain the solar time to compare it with the time of the prime meridian, as indicated by their chronometer, they prefer morning and evening observations to those made at noon. From this difference they readily determine their longitude. From the appended list of cities with longitude, the local time may thus be determined, and the time at one's home may also be compared with that of other places. It should be borne in mind that it is the mean solar time that is thus considered—which in most cities is not the time of the watches and clocks there. People all over Great Britain set their watches to agree with Greenwich time; in France with Paris; in Japan, with Kobe, etc.

To avoid the frequent changes of time necessary while travelling east or west when different cities use mean local sun time, and to secure relative uniformity, the United States, Canada, Mexico and nearly all other nations have adopted systems whereby the clocks within a belt of approximately fifteen degrees in width east and west, indicate the same time. This was begun in a systematic way in the United States, November 18, 1883, when our principal railways so changed their time that stations approximately within 7½° from the 90th meridian west from Greenwich changed their clocks six hours earlier than Greenwich time, and all other changes thruout the country were changes of whole hours. In accordance with the theory underlying the system, all places in the United States and Canada within 7½° of the 75th meridian use the average sun time of that meridian. The clocks of this, the Eastern Standard Time belt, will thus have their minute and second hands pointing exactly as the minute and second hands of London clocks, the hour hands of the latter, pointing five hours later. The longitude of Philadelphia being very nearly 75° W., sun time and clock time will be the same at that place. In New York city and Boston the mean sun time will be ahead of clock time, since watches and clocks there are set according to the mean sun time of the 75th meridian but are east of it; hence it gets noon by the sun in those cities before it is twelve o'clock. In places which use eastern time but are west of the 75th meridian, solar time is later than clock time.

The center of the next hour belt to the west is, of course, fifteen degrees from the 75th meridian or 90° W. Madison, St. Louis and New Orleans being very nearly on this meridian, their sun time and clock time will agree and the sun's shadow average due north at twelve o'clock. The next or Mountain Standard Time belt has for its center meridian 105° W., the longitude of Denver. West of this lies the Pacific Standard Time belt. Clocks in this belt are set by average sun time on the 120th meridian which forms a part of the western boundary of California. In the extreme eastern portions of British America—New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland, and also in Porto Rico, the time of the 60th meridian is used. This belt is called the Intercolonial Standard Time belt. The American railways of Alaska use Alaska Standard Time, based upon the 135th meridian, or one hour slower than Pacific time.

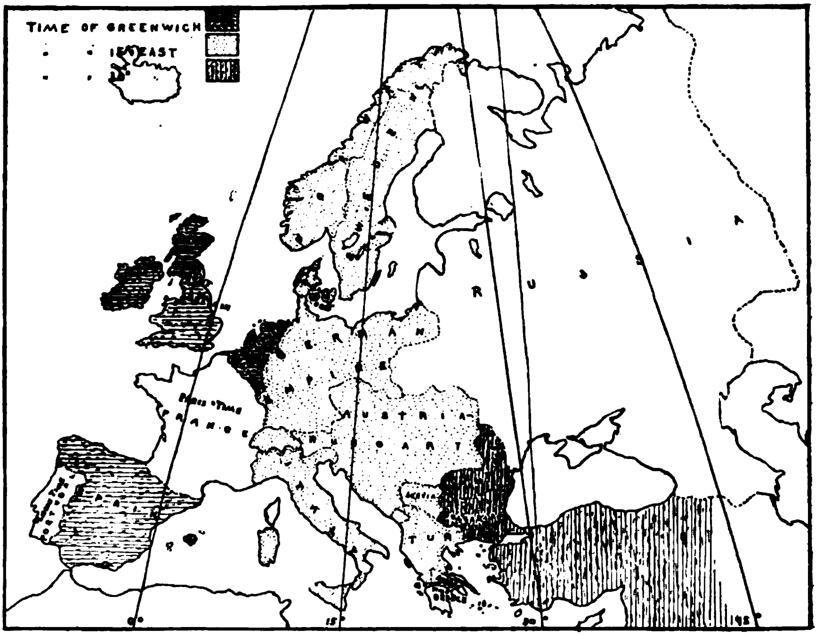


FIG. 3. STANDARD TIME BELTS OF EUROPE.

Within the past few years the principal nations of the world have adopted standard time systems. In most cases the time is reckoned by whole or half hours from Greenwich. Following is a list of the principal countries having standard time, with the meridian used as standard for regulating the time and a comparison of the time used with that of Greenwich.

Country	Meridian	Time compared with Greenwich
Austria	15° 00′ E.	1 hr. faster.
Belgium	00 00	Same.
Bosnia	15 00 E.	1 hr. faster.
Bulgaria	30 00 E.	2 hr. faster.
Cape Colony	22 00 E.	1 hr. 30 min. faster.
Cuba	82 30 W.	5 hr. 30 min. slower.
Denmark	15 00 E.	1 hr. faster.
France	2 20 15″ E.	9 min. 21 sec. faster.
Germany	15 00 E.	1 hr. faster.
Great Britain	00 00	Same.
Greece	23 45 E.	1 hr. 35 min. faster.
Holland	00 00	Same.
Italy	15 00 E.	1 hr. faster.
Japan	135 00 E.	9 hr. faster.
Luxemburg	15 00 E.	1 hr. faster.
Luzon, P. Is	125 00 E.	8 hr. 20 min. faster.
Mexico	99 00 W	6 hr. 36 min. slower.
Natal	30 00 E.	2 hr. faster.
New Zealand	172 30 E.	11 hr. 30 min. faster.
Norway	15 00 E.	1 hr. faster.
Portugal	9 08 W	36 min. 32 sec. slower
Queensland	150 00 E.	10 hr. faster.
Rumania	30 00 E.	2 hr. faster.
Sandwich Islands	157 30 W	10 hr. 30 min. slower.
Servia	15 00 E.	1 hr. faster.
South Australia	135 00 E.	9 hr. faster.
Spain and Balearic Islands	00 00	Same.
Sweden	15 00 E.	1 hr. faster.
Switzerland	15 00 E.	1 hr. faster.
Tasmania	150 00 E.	10 hr. faster.
Turkey		
Western Europe	15 00 E.	1 hr. faster.
Eastern Europe and Asia	30 00 E.	2 hr. faster.
Victoria	150 00 E.	10 hr. faster.
West Australia	120 00 E	8 hr. faster.

It was stated above that in theory the standard time sections are fifteen degrees wide. In actual practice, cities near the theoretical boundary of a belt adopt the time of either belt as they choose. In theory, the western boundary of the Central section of the United States is 97½° W., whereas in Bismarck, N. D., nearly 101° W., Central time is used. The time used by railways is usually adopted by the cities thru which they pass; so if the railways in that city should adopt Mountain time, the boundary of the belt would be shifted to the nearest place where a change is made.

In a few cities where different railways use the time of different belts, the city uses the time of neither belt but uses instead mean local sun time. The following editorial comment in the Official Railway Guide for November, 1900, very succinctly sets forth the condition which has prevailed in Detroit as regards standard and local time.

"The city of Detroit is now passing thru an agitation which is a reminiscence of those which took place thruout the country about seventeen years ago, when Standard Time was first adopted. For some reason, which it is difficult to explain the city fathers of Detroit have refused to change from the old local time to the Standard, notwithstanding the fact that all of the neighboring cities —Cleveland, Toledo, Columbus, Cincinnati, etc.,—in practically the same longitude, had made the change years ago and realized the benefits of so doing. The business men of Detroit and visitors to that city have been for a long time laboring under many disadvantages owing to the confusion of standards, and they have at last taken the matter into their own hands and a lively campaign, with the coöperation of the newspapers, has been organized during the past two months. Many of the hotels have adopted Standard time, regardless of the city, and the authorities of Wayne county, in which Detroit is situated, have also decided to hold court on Central Standard time, as that is the official standard of the state of Michigan. The authorities of the city have so far not taken action. It is announced in the newspapers that they probably will do so after the election, and by that time, if progress continues to be made, the only clock in town keeping the local time will be on the town hall. All other matters will be regulated by Standard time, and the hours of work will have been altered accordingly in factories, stores and schools. Some opposition has been encountered, but this, as has been the case in every city where the change has been made, comes from people who evidently do not comprehend the effects of the change. One individual, for instance, writes to a newspaper that he will decline to pay pew rent in any church

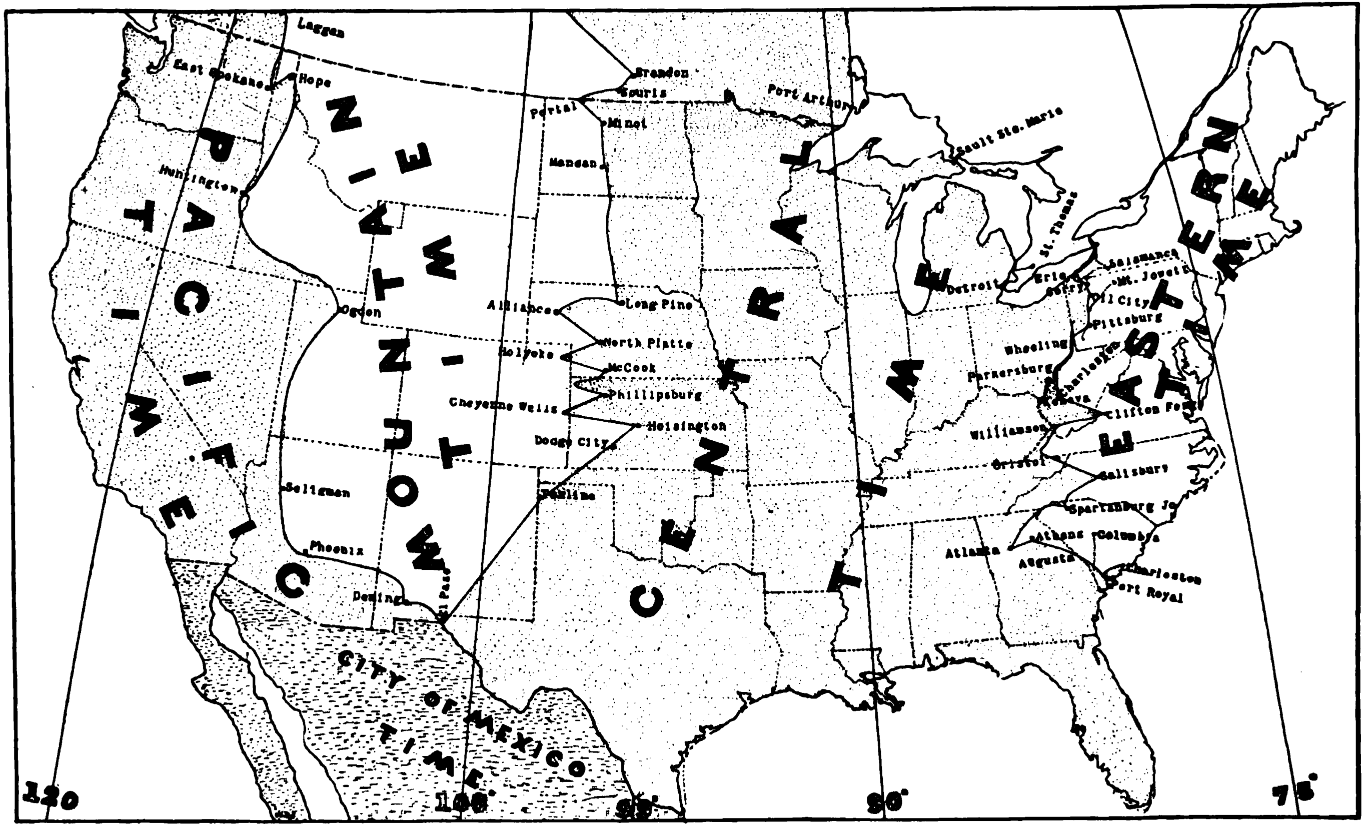


FIG. 4. MAP OF THE UNITED STATES SHOWING STANDARD TIME BELTS.

whose clock tower shows Standard time; he refuses to have his hours of rest curtailed. How these will be affected by the change he does not explain. Every visitor to Detroit who has encountered the difficulties which the confusion of standards there gives rise to, will rejoice when the complete change is effected."

The longitude of Detroit being 83° W., it is seven degrees east of the 90th meridian, hence the time used in the city was twenty-eight minutes faster than Central time and thirty-two minutes slower than Eastern time. In Gainesville, Ga., mean local sun time is used in the city, while the Southern railway passing thru the city uses Eastern time and the Georgia railway uses Central time.

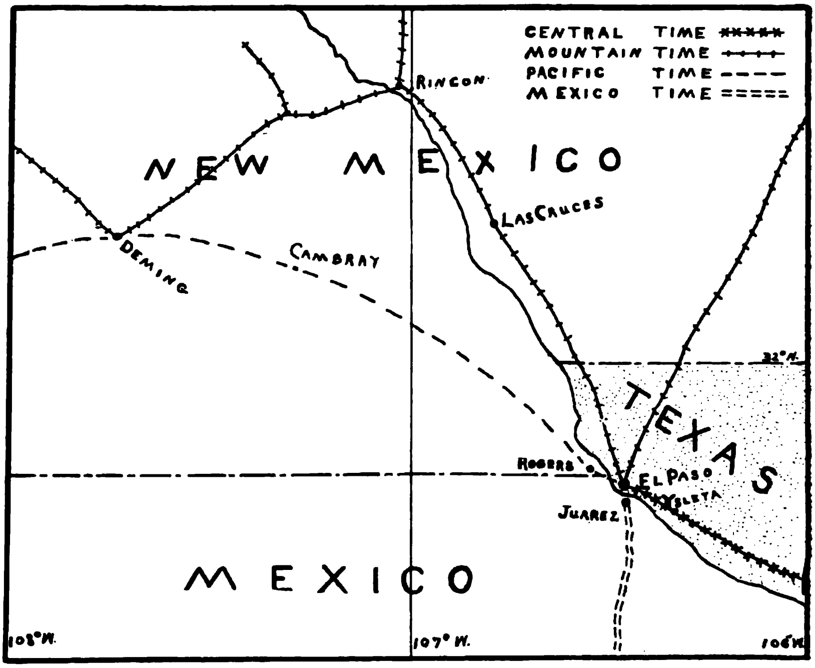


FIG. 5. RELATIONS AT EL PASO WHERE FOUR TIME BELTS MEET.

Another place of peculiar interest in this connection is El Paso, Texas, from the fact that four different systems are employed. The city, the Atchison, Topeka and Santa Fe, and the El Paso and Northern railways use Mountain time. The Galveston, Harrisburg and San Antonio, and the Texas and Pacific railways use Central time. The Southern Pacific railway uses Pacific time. The Mexican Central railway uses Mexican Standard time.

From this it will be seen that when clocks in Rogers, N. M., a few miles from El Paso, are striking twelve, the clocks in El Paso are striking one; in Ysleta, a few miles east, they are striking two; while across the river in Juarez, Mexico, the clocks indicate 12:24.

How to find the mean local time of a place. When it is noon by the sun on the 90th meridian, it is noon there by the clock and also noon by the clock in every place using Central time. All places using Central time which are east of the 90th meridian, will have their noon by the sun before twelve o'clock, and all places using Central time which are west of that meridian will have noon by the sun after twelve o'clock. Assume we are at Ysleta, Texas, longitude about 106½° W. When the clock strikes twelve, the sun's shadow is, on the average, due north on the 90th meridian. It is manifest, then, that the sun being 16½° east of us, our shadow is west of north and will not be north for one hour and six minutes, the time it takes the sun to travel 16½°. The sun's shadow will be due north at Ysleta, then, at 1:06 P. M. It should be remembered that this is true only when apparent and true sun time are the same. This occurs about April 15, June 15, August 31, and December 25; at other dates, the actual position of the sun, being somewhat fast or slow as compared with the average. At El Paso, in practically the same longitude as Ysleta, the sun's shadow will be north at 12:06 P. M., since it is north on the 105th meridian when clocks which are set by that meridian and thus have Mountain time, strike twelve. For similar reasons, at Juarez, where clocks are regulated by 99th meridian time, the sun will be 7½° eastward when their clocks strike twelve, or thirty minutes behind the clock, and at Rogers, it will be 54 minutes ahead of the clock or cast a north shadow at 11:06 A. M.

At Bergen, Norway, the standard time is based on the mean sun time of the 15th meridian east of Greenwich. The longitude of its Cathedral being 5° 20′ 15″ E., it is 9° 39′ 45″ west of the meridian which gives it its time. The sun time will, therefore, be thirty.eight minutes and thirty-nine seconds behind clock time. From the list of cities with their longitude and the list of standard time adoptions, one can ascertain the mean local time of the principal cities of the world.

The longitude of the following cities is taken from various authorities such as the United States Coast and Geodetic Survey, Nautical Almanac, Official Survey Reports of various nations, etc.

Where possible the exact place is given, the abbreviation "O" standing for observatory and "C" for cathedral.

	°	′	″	
Adelaide, So. Australia, Snapper Pt	138	30	39	E
Aden, Arabia, Tel. Sta	44	58	58	E
Alexandria, Egypt, Eunos Pt.	29	51	40	E
Amsterdam, Holland, Church.	4	53	04	E
Antwerp, Belgium, O.	4	24	44	E
Apia, Samoa, Ruge's Wharf.	171	44	56	W
Athens, Greece, O	23	43	55	E
Bankok, Siam, Old Brit. Factory	100	22	38	E
Barcelona, Spain, Old Mole Light	2	10	55	E
Batavia, Java, O	106	48	25	E
Bergen, Norway, C	5	20	15	E
Berlin, Germany, O	13	23	44	E
Bombay, India, O	72	48	58	E
Bordeaux, Fr., St. Andrew	00	34	42	W
Brussels, Belgium, O	4	22	10	E
Buenos Ayres, Custom H	58	22	14	W
Cadiz, Spain, O	6	12	20	W
Calcutta, Ft. Wm. Semaphore	88	20	11	E
Canton, China, Dutch F. Light	113	16	34	E
Cape Town, S. Africa, O	18	28	40	E
Caracas, Ven., Summit	66	50	55	W
Cayenne, Fr. Guiana, Land'g	52	20	25	W
Christiania, Norway, O	10	43	35	E
Constantinople, Turkey, C	28	58	59	E
Copenhagen, Denmark, New O	12	34	47	E
Dublin, Ireland, O	6	20	30	W
Edinburgh, Scotland, O	3	10	54	W
Florence, Italy, O	11	15	22	E
Gibraltar, Spain, Dock Flag.	5	21	17	W
Glasgow, Scotland, O	4	17	39	W
Hague, The, Holland, C	4	18	30	E
Hamburg, Germany, O	9	58	25	E
Havana, Cuba, Morro	82	21	30	W
HongKong, China, C	114	9	31	E
Jerusalem, Palestine	35	13	00	E
Leipzig, Germany, O	12	23	30	E
Lisbon, Portugal, O	9	11	10	W
Liverpool, England, O	3	04	16	W
Madras, India, O	80	14	51	E
Manila, Luzon, O	120	58	33	E
Marseilles, Fr. New O	5	23	43	E
Melbourne, Victoria, O	144	58	32	E
Mexico, Mexico	99	05	00	W
Montevideo, Uruguay C	56	12	15	W
Moscow, Russia	37	34	00	E
Munich, Germany, O	11	36	32	E
Naples, Italy, O	14	14	44	E
Panama, Central Am. C	79	32	12	W
Para, Brazil, Custom House	48	50	05	W
Paris, France, O	2	20	14	E
Peking, China	116	28	54	E
Rio de Janeiro, Brazil, O	43	10	21	W
Rome, Italy, O	12	28	40	E
Rotterdam, Hol., Time Ball Station	4	28	50	E
St. Petersburg, Russia, O	30	19	22	E
Stockholm, Sweden, O	18	03	30	E
Sydney, New So. Wales, O	151	12	23	E
Tokio, Japan, O	139	44	30	E
Valparaiso, Chili	71	41	45	W
Venice, Italy, C	12	20	29	E

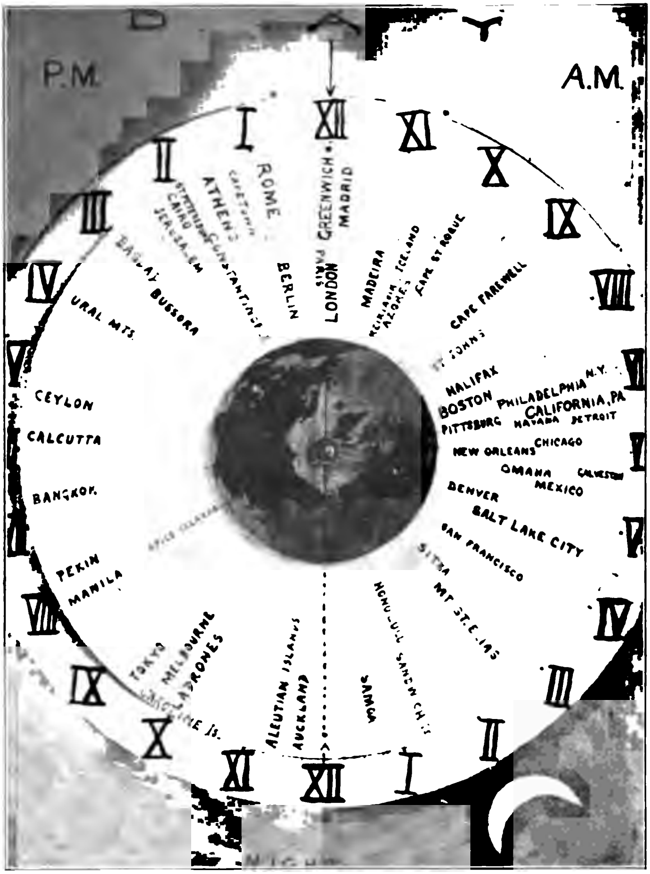
UNITED STATES	°	′	″	
Albany, N. Y., O	73	44	56	W
Annapolis, Md., O	76	29	08	W
Atlanta, Ga	84	20	00	W
Attu Island., Alaska, Chichagoff	173	12	24	E
Augusta, Me	69	50	00	W
Austin, Texas	97	42	00	W
Baltimore, Md., Wash. Mt	76	36	59	W
Bangor, Me., Austin Hill	68	46	59	W
Boise, Idaho	116	20	00	W
Boston, Mass., State House.	71	03	50	W
Buffalo, N. Y	78	55	00	W
Carson City, Nev	119	48	00	W
Charleston, S. C., Light H	79	52	08	W
Charleston, W. Va	81	31	00	W
Cheyenne, Wyoming	104	42	00	W
Chicago, Ill	87	37	00	W
Cincinnati, Ohio	84	26	00	W
Cleveland, Ohio	81	42	06	W
Columbia, S. C	81	51	00	W
Columbus, Ohio	82	59	00	W
Denver, Col	104	59	23	W
Des Moines, Iowa	93	37	30	W
Detroit, Mich	83	02	54	W
Duluth, Minn	92	06	10	W
Erie, Pa	80	08	00	W
Fargo, N. D	96	47	00	W
Galveston, Texas, C	94	47	25	W
Hartford, Conn	72	40	45	W
Helena, Mont	111	52	45	W
Honolulu, Sandwich Is	157	51	34	W
Indianapolis, Ind	86	05	00	W
Jackson, Miss	90	06	00	W
Jacksonville, Fla., Church	81	39	14	W
Kansas City, Mo	94	37	40	W
Key West, Fla., Light House	81	48	04	W
Lansing, Mich	84	32	00	W
Lexington, Ky	84	33	00	W
Lincoln, Neb	96	45	00	W
Little Rock, Ark	92	16	00	W
Los Angeles, Cal. Ct. House	118	14	32	W
Louisville, Ky	85	30	00	W
Lowell, Mass	71	19	02	W
Lynn, Mass	70	57	27	W
Madison, Wis	89	20	00	W
Manila, Luzon, O	120	58	33	E
Memphis, Tenn	90	05	00	W
Milwaukee, Wis	87	57	00	W
Minneapolis, Minn	93	18	00	W
Mobile, Ala., Church	88	02	28	W
Montgomery, Ala	86	25	00	W
Nashville, Tenn	86	49	00	W
Newark, N. J	74	10	00	W
New Haven, Conn., Yale	72	55	45	W
New Orleans, Mint	90	03	28	W
Newport, R. I., Torpedo Sta	71	19	40	W
New York, N. Y., City Hall	74	00	24	W
Olympia, Wash	123	00	00	W
Omaha, Neb	95	56	00	W
Philadelphia, State House	75	09	03	W
Pittsburg, Pa	80	02	38	W
Portland, Oregon	122	27	30	W
Porto Rico, P. O., Morro	66	07	28	W
Providence, R. I., Unit. Ch	71	24	19	W
Raleigh, N. C	78	40	00	W
Richmond, Va	77	27	28	W
Rochester, N. Y	77	51	00	W
Sacramento, Cal	121	26	00	W
St. Louis, Mo	90	15	16	W
St. Paul, Minn	93	05	00	W
San Francisco, Coast Survey Station	122	24	32	W
Santa Fe, New Mexico	106	10	00	W
Savannah, Ga., Exchange	81	05	26	W
Sitka, Alaska, Parade Gr'nd	135	19	31	W
Springfield, Mass	72	35	45	W
Stockton, Cal	121	14	00	W
Tallahassee, Fla	84	24	00	W
Topeka, Kan	95	40	00	W
Trenton, N. J	74	46	30	W
Troy, N. Y	73	41	00	W
Virginia City, Nev	119	35	00	W
Washington, D. C., O	77	03	06	W
Wilmington, Del., Town Hall	75	38	03	W
Winona, Minn	91	30	00	W
Worcester, Mass.	71	48	13	W

THE RELATION OF LONGITUDE TO TIME

BY HERMAN T. LUKENS, STATE NORMAL SCHOOL, CALIFORNIA, PA.

The illustration on page 134 represents a piece of apparatus arranged to illustrate the relation of longitude and time. The central part, consisting of the northern hemisphere with a circular disk of cardboard attached to it, is movable and can be turned from right to left to represent the earth's rotation from west to east. The immovable ring beyond the outer margin of this disk is divided into twenty-four equal parts corresponding to the twenty-four hours of the day. The arrow at the top of the chart shows the direction of the sun's rays and points to the noon hour. The afternoon hours follow to the left and the evening hours extend below where the darker night sky is seen with the Great Dipper on the left and the crescent moon on the right. Midnight is represented at the bottom of the chart and is followed by the early morning and forenoon hours upward to XII again. The purpose of the circular disk of cardboard attached to the wooden hemisphere in the center is simply to afford space on which to write the geographical names large enough to be seen across the room. The names are written on the radiating lines extending from the meridians of the places on the hemisphere. The black line extending vertically across the hemisphere represents the prime meridian of Greenwich. The somewhat irregular dotted line shows the position of the international date line.

The photograph shows the apparatus set for noon at Greenwich. The local time of every other place can be read off by simply following its meridian down to the equator on the wooden hemisphere and outward on the cardboard disk to the ring of the hours. It is, however, more than a calculating machine, for it also shows the reason for its answer. The world really turns thru the hours, as the model turns thru its hour circle. If our clock faces were arranged with twenty-four hours instead of twelve, we should have a good model of the daily motion of the earth constantly before us. The changing position of the hour hand would then correspond to the changing direction of the standing position of a man during every portion of the twenty-four hours.



(From a photograph of the apparatus made by Professor Lukens.)

What time is it at Bagdad, when it is half-past nine o'clock in the morning at Philadelphia? Turn the hemisphere from right to left until the meridian of Philadelphia is brought opposite to half-past nine o'clock a. m. By looking now at the meridian of Bagdad we see it is opposite half-past five o'clock p. m. Of course we have not only the local time at Bagdad before us, but we can equally well read off the time it is at any other place at that moment. For instance, it is ten minutes after midnight in the morning of the following day at Melbourne.

The international date line is marked on the wooden hemisphere. As the hemispere turns from west to east all meridians are in succession brought opposite the hour of midnight at the bottom of the chart. The day begins first at the international date line and begins later and later for all other meridians in proportion to their distance west from the 180th. The less their longitude east or the greater their longitude west, the later does the day begin. The new century will begin first, therefore, in that place which is nearest to the international date line but west of it. In the northern hemisphere this place is the eastern extremity of Siberia, but the Russians use the Julian calendar and are therefore behind. In the southern hemisphere the century begins first on the Friendly Islands which are included in the Australian day. As some of them are as much as 174 degrees west longitude, January 1st will begin twenty-four minutes sooner there than at the meridian of 180 degrees, or, seventeen hours and twenty-four minutes before the century begins at Philadelphia, Pa. The position of the international date line is marked on the movable disk by a star (*) and the letter "A" (antipodes). As this point turns past the hour of midnight, we have represented before us between this point ($\overset{*}{A}$) and the hour of XII (at the bottom of the chart) all those places on the earth that already have the new day; whereas all the remaining meridians have still the previous day.

The daily motion of the earth on its axis is represented by the complete rotation of the hemisphere from west to east.

The use of this piece of apparatus in class has still further impressed me with the importance of actual models in teaching the fundamental conceptions of geography. The use of flat maps is very objectionable; and the use of Mercator's Projection is calculated to instil wrong conceptions that will never be overcome. The chief difficulties come from our awkward and distorted diagrams or, worse still, from teaching by mere words. Sense-impression is the beginning of all knowledge.

A SERIES OF LESSONS LEADING TO LAPLACE'S NEBULAR HYPOTHESIS

(Continued from Vol. II, page 44)

BY THEDA GILDEMEISTER, WINONA, MINN.

LESSON V. GRAVITY AND SPECIFIC GRAVITY

SUB-LESSON A

AIM: To have children (*a*) study a third form of molar attraction called *gravity,* (*b*) know methods and results of measuring this force, and (*c*) realize man's dependence upon it.

PREPARATION:

1. *Materials.* Sod; glasses of cold water; loam; sand; common starch; brick; stone; wood; marble or pebble; penny; feather; ball; scales; weights; a bag of feathers, or milkweed- or thistledown; sheets of tissue paper; water in leaky pan or in a bottle. If an air pump can be easily obtained, perform the experiment of the "penny and feather" instead of describing it. Also have some quinine capsules and shot, and, if possible, a "Brownie" made from an old cuff and containing a large marble.

2. *Children's Minds.* What forms of attraction have we already studied? In what way did we find the last two differing from the first two? (See Generalization, page 36 of Vol. II.) Today we shall study a third form of molar attraction—a force acting at even greater distances than did magnetism.

PRESENTATION (of *a* under *Aim*):

All may use your note books and pencils, and as many as possible may help in performing some experiments which we will note now and discuss later.

Experiment 1. Hang up this piece of sod on that hook, so that it will not touch any other object.

Experiment 2. Mix sand with the water in this glass.

Experiment 3. Mix loam with the water in this one.

Experiment 4. Put common starch in this one.

Experiment 5. Toss this ball straight upward.

Experiment 6. Throw it toward the wall.

Experiment 7. Several children hold out hands, palms upward. In each hand teacher lays a stone, brick, piece of lead, wood, or whatever she desires. One after another, each pupil turns his hand over, paying no attention to the contents.

Experiment 8. Pull the rag from a hole in an old pan containing water: or, uncork an inverted bottle of water; or, pour water into a glass tube, or rubber hose, or wooden trough.

Observations upon the above experiments: [Note. Teacher may have to wait until the next day to obtain results from experiments 1–4, altho they were purposely performed early in the recitation.]

1. Look at the sod carefully, and at the floor underneath. Has anything occurred? What caused the particles of dirt to fall? What forces were acting in the sod when we hung it up? The force which overcame both the cohesion and adhesion in the sod is called *gravity*, and we shall soon discover more about it and what it does. (Name taught by sight and sound.)

2–4. What has happened to our solutions? What force has here been overcome? The same force that caused the dirt to fall from the sod caused these substances to "settle" in the glasses. What is its name?

5–6. In each case, what happened to the ball after leaving your hand? What finally became of it? What would have occurred had we been in the yard? The same force was here at work. Write its name.

7. What force was acting when the boys held the objects on their palms? (Muscular force.) What resulted from turning their hands over? How far did the objects fall? Might they have fallen further? What prevented? Again what force acted?

8. Did the water fall as far as it could? What is similar in all of our experiments?

Let us now see whether from all these experiments we can tell what *Gravity is.* (Encourage voluntary expression and original thought, but if no one arrives at the correct conclusion, teacher may question.) At the beginning of the recitation, what did I say we were to study? What did I say about its action? Had we been out of doors, each object would have stopped where? Towards what, then, do we find all of these masses attracted? (The Earth's surface.) Suppose you had thrown your ball into an open well, would it have stopped on a level with the Earth's surface? Then, where must this attractive power, called *Gravity*, reside? (Within the Earth.)

What sort of bodies did the *magnet* attract? The electrified *sealing wax?* The *Earth* attracts what sort? Name the substances in our experiments which we found the Earth attracting. Name others which you have known it to attract. Is there a girl here who has not at some time broken a dish or vase by having gravity assume control of it? Is there a boy who hasn't fallen from a tree or fence? Can you think of any substances which it does *not* attract? (Perhaps *smoke* and *steam* may be named. If so, say that we shall soon try some experiments which will help to show that smoke and steam are not exceptions.)

There are, then, no substances which the Earth does not attract. (Lead children to volunteer definitions until one similar to this is obtained: Gravity is the attraction which the Earth has for all bodies on or near its surface.)

Now let us try some experiments to see whether gravity acts equally upon all bodies.

Experiment 9. Drop at the same instant a marble and a sheet of tissue paper. Which reached the floor first?

Experiment 10. Repeat, after wadding the paper into as small a ball as possible. Same question.

Experiment 11. Drop simultaneously a penny and a feather. Tell of experiment with air pump. See any text on Physics.

Experiment 12. Same with a half-pound weight and a bundle of feathers weighing one-half pound. (Refer to old story of little girl and the school "committee man.")

Experiment 13. Drop at the same time a cork and a lump of lead. Try several times.

Experiment 14. Try as many different objects as time allows.

Obtain from these experiments the statements that (1.) The weight of an object has nothing to do with the rate of falling, and (2.) The buoyancy of the air partially counteracts the force of gravity. We see this in the cases of *a*, the single feather or thistledown; *b*, the spread sheet of tissue paper; *c*, smoke; *d*, steam. We also find that gravity, like the earlier forces studied, can be overcome by other forces, two of which we have today noted, viz., ***mus-***

cular force and *buoyancy of the air.* Query: What do we see smoke doing on damp days when the air is not so buoyant?

b (under *Aim.*) All are familiar with weight and the fact that different substances differ in weight. Shall we now see what we mean by this?

Experiment 15. Each hold out your hand, palm upwards. Lay in it your pencil. Look carefully at your hand and arm and also note the feeling.

Experiment 16. Lay in your hand the heaviest book that you have. Compare results with same observations upon Experiment 15. In which case did you have to exert more muscular effort? What force had to be overcome? Had the Earth more attraction for the one object than for the other? The force which you exerted in each case can be measured by means of these scales. (Let a few children, as time permits, weigh both pencil and book.) We call this measuring, *weighing*, and by it we measure two forces. Can you tell what? (The muscular force exerted in overcoming gravity, and the force which the Earth exerts in drawing the objects towards itself.) We may, then, define *weight* in either one of two ways. (1) It is the measurement of the force of gravity. (2) It is the measurement of the force (can this be anything besides muscular force?) required to prevent bodies from falling.

The teacher may now touch upon the facts indicated in the following outline as she deems best.

1. Weight depends upon density (see Deschanel's or any other "Natural Philosophy.")

2. Gravity is not equally strong at all places upon the Earth's surface.
   - *a.* At level of sea. (standard.)
   - *b.* On mountain tops.
   - *c.* At equator.
   - *d.* At or near poles. (In this connection take time to explain meaning of "oblate spheroid" and its cause. Also centrifugal force and its results, as they will be needed in the last lesson of the series.)

3. Action of gravity below Earth's surface.
   - *a.* In wells or deep mines.
   - *b.* As we near center of Earth.
   - *c.* At center of Earth.

c (under *Aim.*) We have still another point to consider and that is the value of this force to us who live upon the Earth. In the third grade when you learned of the Earth's sphericity and motions, you wondered, as did men in the days of Columbus and of Galileo, why people didn't fall off the Earth or the water spill out of the lakes and oceans, and you read in your "Brooks and Brook Basins" (pages 86 and 87) that the Earth acts like a great magnet, holding us fast no matter what its position. You have, to-day, learned the name of this great force which permits us to live so securely upon a sphere that carries us, in our locality, round and round at the rate of over seven hundred miles an hour, and sails with us thru space even more rapidly, traveling in one second about eighteen and one-half miles.

Let us now name as many of Gravity's wonderful works as we can, and think of even more for tomorrow.

SUGGESTIVE LIST FOR TEACHER upon which she may, at will, elaborate:

1. Gravity holds *us* upon the Earth.

2. Gravity keeps about the Earth our atmosphere, without which we could not live. (More than fifty miles high.)

3. Gravity keeps in place our homes, churches, libraries, utensils, trees, animals, etc.

4. It causes the colder and heavier currents of air to "sink," thus equalizing the temperature of the atmosphere and causing *winds.* These winds push the clouds, sweep the hills, etc.

5. In a similar way, gravity causes ocean currents, the benefit of which we have learned.

6. The clouds are by gravity made to ride near the Earth, tempering the sun's heat and giving us moisture. Without gravity the rain, hail, snow, etc., would not fall.

7. Gravity holds the ocean waters in place and prevents their engulfing the land as the Earth rotates.

8. Gravity made the mountains for, you remember, as it pulled upon the Earth's hardened crust, then too large for the shrunken interior, the mountain ridges rose. (Tarr and McMurry, Book I, page 126.)

9. Gravity draws downward the water which falls from the clouds. Some it draws into the Earth as far as possible and we

later have wells and springs. (Any text upon Physics or upon Physical Geography.)

10. It draws some of this water into the very interior of the earth, where the heat expands it, causing explosions, sometimes felt in the form of earthquakes or volcanoes.

11. The waters which are not drawn into the earth, are, by gravity, made to flow as creeks and rivers into old Ocean. We are thus provided with one means of transportation as well as sewerage, water-power, erosion, deposition of alluvial plains, etc. (Review uses of *rivers.*)

12. Gravity causes great boulders to roll down mountain sides (after frost and water have loosened them) crumbling them into smaller and smaller bits. Thus is formed *soil* without which we could have little vegetable life and hence little animal life. (Review uses of *soil.*)

13. Without gravity our present system of city water works would be impossible.

14. We are enabled by gravity to have a clock in our schoolroom, for it is gravity which causes the pendulum to swing.

15. By means of the plumb line we can build walls correctly.

16. The preceding are some of the grander works of gravity. The following are minor, but they add to our list. We could not play ball very often, if gravity did not bring the ball to Earth, for we could not afford a new ball each time we wished to toss one upward.

17. Gravity helps the laundress economize, for on each ironing day she "cold starches" the collars, etc., then allows the starch to "settle," later pours off most of the water, permits the remainder to evaporate, and uses again the deposited starch which gravity has saved for her.

18. Gravity draws the heavier part of milk to the bottom of the crock and allows us to enjoy the use of *cream* upon our oatmeal, etc.

19. Oil will also for the same cause float upon water.

20. Many toys depend upon gravity for their action. (Look at this Brownie. I set him up on the upper end of this oblique board so you may see him. Why! what has become of him? What caused him to land so quickly at the bottom of this miniature toboggan slide? Here is a large shot and a quinine capsule for each of you. Put the shot inside the capsule. Lay it on the

upper part of your desk, or on a slanting book. What occurs? To make this more amusing, draw in ink a funny face upon each capsule. Now try. You may take these home for your little brothers and sisters to enjoy.)

ASSOCIATION AND COMPARISON:

1. *Magnetism* and *gravity* compared and contrasted.

2. Compare relative *strength* of gravity and the molecular forces, cohesion and adhesion.

> Which is easier for man to do, lift a ten-pound stone (overcoming what force?) or pull the stone apart (overcoming what force?) ?

3. Compare *largeness* of the same forces, seeing that gravity is an almost *universal* force. Tho easily overcome for the moment, it never ceases acting. Is this true of our other forces?

4. Study the opposition of forces, as in previous lessons, finding that gravity overcomes *adhesion* in our experiments with

   a. Glass of water and soil, sand, starch, water-color paints, etc.

   b. Dirt from sod. We could here add plastering from ceiling and loosened brick from a chimney.

We find, too, that at times one force rules, and then another, as in

   a. Muscular force vs. gravity. (Give examples of each.)
   b. Buoyancy of air vs. gravity. (Give examples of each.)
   c. Adhesion vs. gravity. (Think how our brick houses, chimneys, etc., stand for years. What force finally conquers?)
   d. Cohesion vs. gravity. (Give examples.)
   e. Magnetism vs. gravity.
   f. Frictional electricity vs. gravity.

GENERALIZATIONS:

1. *Gravity* is the attraction which the Earth has for all bodies on or near its surface.
2. *Weight* is the measurement of the force of gravity.
3. *Gravity* is absolutely essential to life upon the Earth.

APPLICATIONS (immediate):

1. Write the names of ten entirely different substances which the Earth attracts.
2. Name five light and five heavy substances.

3. Name some substances upon which gravity *seems* not to act. Prove that these are not exceptions.

4. Define gravity. 5. Define weight.

6. Write as many as possible of the services which gravity renders man.

SUB-LESSON B

AIM: To teach the meaning of "center of gravity" and the value of this knowledge in everyday life.

[Note: As the presentation of the first part of this aim is so admirably given in Gifford's "*Elementary Lessons in Physics—Teachers' Edition*" it does not seem best to repeat it here. The book is valuable for any teacher of intermediate grades.]

APPLICATION:

Of what value in life is our knowledge of the center of gravity? Let us see whether we may not have learned this *practically* long before we knew the name. Have you ever watched a little child learning to walk? What happens at first? (Child falls continually). What does he learn to do? (He learns to *balance* himself, or to put out his little feet and bend his little back, so that the *line of direction* shall fall between his feet). He has discovered the law of gravity, the position of the "center of gravity," and has learned to control both. Last year I saw you solving the same problem when you were learning to walk on stilts. A man who needs to use crutches must learn the same lesson. Think of other acts which illustrate these principles:

1, running; 2, skating on ice and on roller skates; 3, walking up a ladder, on railroad rails, on cracks in the sidewalk, on fences, on the tight-rope; 4, riding a bicycle.

Mechanics defer to the laws of equilibrium, and consequently furnish us both machines and toys. How does the tricycle illustrate this? The step ladder? The Bunker Hill Monument? The stability of the pyramids made by the ancient Egyptians has passed into a proverb.

The toys pictured in Steele's "Fourteen Weeks in Physics" and in Deschanel's "Natural Philosophy" can be crudely but satisfactorily made by some of the school boys and used as illustrations. The following experiment, tho old, has never been seen in a book, so is here fully described.

Open a knife so that one blade and the handle form a right angle. Stick the point of the knife blade firmly into the wood of an ordinary pencil at about one or two inches from the point, according to the pencil's length. The right angle made by the knife's blade and handle must *open* towards the point of the pencil. The whole apparatus may now be supported in neutral equilibrium if the pencil point be placed on the edge of a desk so that the knife may hang under it. Only experiment will show where to place the knives in the different pencils, which may be made to stand at various angles with the horizontal plane of the table. They may be knocked gently and even moved from side to side.

SUB-LESSON C

AIM: To learn by experiment the meaning of "specific gravity."

PREPARATION:

1. *References.* Deschanel's "Natural Philosophy," pp. 85-89 and others, Gifford's "Elementary Lessons in Physics—Teachers' Edition" pp. 57-61, and Steele's "Fourteen Weeks in Physics," pp. 92-97.

2. *Materials.* Specimens of stone, coal, wood, iron, brass, cork, glass, etc. A spring balance, some pans, buckets, string, etc., as needed in the experiments.

3. *Children's Minds.* We found in our study of gravity that different substances differ in weight. Name a few heavy materials. Some light materials. We learned, too, that this difference in weight is due to differences in density. Men frequently wish to know the exact volume of a given body but because of its peculiar shape find this impossible. If now, they could only know the relative weight of this body as compared with some other material more easily weighed and a cubic foot of which would always weigh the same, we should not need to estimate each separate volume required. To-day we are to see how this may be done.

PRESENTATION: The teacher must, of course, present this according to her materials and apparatus, so it is here merely outlined. Let the pupils do as much of the work as possible.

I. *To find specific gravity of solids heavier than water.*

1. Weigh solid in usual manner. Record weight in note book.
2. Weigh same solid in water. Record weight.

3. Weigh the displaced water.

4. Compare weight obtained in 3 with difference in weights obtained in 1 and 2. What does this show?

5. Compare weight of solid in air with weight of displaced water. What is the ratio? Call this ratio the *specific gravity* of the solid, that is, the *special weight* it has when compared with water.

6. Repeat experiment, finding specific gravity of all other substances which teacher has.

7. Make a "table" showing specific gravity of various substances tried.

8. Questions and statements by the teacher to show children why water is used as the standard, and how.

   a. Universal element. Can be had anywhere on Earth where men wish to experiment.

   b. Moves easily so that amount displaced may be accurately measured.

   c. A given volume's weight

      (1.) Varies with temperature. What proof had we of this in our study of forms of water? (Broken bottle at freezing temperature.)

      (2.) Varies with amount of salt or other mineral contents.

      (3.) Varies with altitude.

   d. To be accurate, then, scientists have had to agree upon altitude, temperature, and sort of water. They therefore use *distilled* water at a temperature of about *39° Fahrenheit,* and perform the experiments at the *sea level,* under which conditions one cubic foot of water weighs about 1,000 ounces. In this way, the world over, men may obtain the same results.

   e. Will the results of our work to-day be accurate? Let us compare our "table" with that in some text-book and see how nearly we agree.

II. *To find specific gravity of solids lighter than water.*

According to children's ability or teacher's time, this may be presented fully or briefly. See references indicated and use either Steele's or Gifford's method. Deschanel's is too complicated.

III. *Specific gravity of liquids.*

Tell children that this can also be done, but not with our crude apparatus. Read a few items from a "table" in some text.

IV. *Specific gravity of gases.*

What is the most common gas about us? (Refer to earlier lessons upon Cohesion.) Therefore, just as water is used in finding the specific gravity of solids, so air is made the standard for gases. We cannot attempt experiments in this line, to-day.

ASSOCIATION AND COMPARISON:

Comparisons made thruout presentation need not be repeated here.

GENERALIZATIONS:

1. By *specific gravity* of a solid is meant its relative weight with that of an equal volume of water.
2. A cubic foot of water weighs about 1,000 ounces.

APPLICATION:

1. Use some of the "Practical Problems" given on p. 96 of Steele.

LESSON VI. GRAVITATION

AIM: To tell children what they can understand of this wonderful force—*gravitation.*

PREPARATION:

Now that you so thoroly understand the force of gravity, it will not be so difficult for you to comprehend the action of another force of which I want to tell you, to-day. We cannot, as before, make any experiments, so you must believe what I tell you.

PRESENTATION:

In studying gravity, I did not tell you of one fact which is interesting, namely, that every particle of matter on the Earth's surface is not only attracted *by* the Earth, but it in turn attracts the Earth. Therefore every time a body falls towards the Earth, the Earth falls towards the body, but the Earth is so many times larger than even the largest body on its surface, that no movement of the

Earth is perceptible, and we consequently ignore its movement in such instances.

What I wish you to understand is that every particle of matter in the universe attracts every other particle. You attract the sun, the stars, the moon; and they in turn attract you and one another. Thus all are bound together in one great whole which we call the *Universe*. Just as we found gravity acting upon every sort of body on the Earth's surface, no matter what its composition, so we find this new force acting upon every sort of body. Gravity is only one form of this new and universal force whose name even is similar—*gravitation* (teacher writes). Gravitation differs from gravity only in its universality. It is gravitation that holds our Earth in its place; that keeps *all* of the planets in their proper orbits; holds in the heavens the fixed stars or suns, of which our sun is one; and prevents our moon and the moons of other planets from sailing off into space. See note p. 52 of Steele, for an illustration of the action of gravitation.

Whatever happens to one atom of this great universe affects all. No matter how insignificant a thing may seem, it, too, is a part of God's great plan and should be so regarded by us who, of all His creatures, are given the power to think and reason, and partially understand the mysteries of the world about us.

Association and Comparison:

1. Compare *gravity* and *gravitation.*
   - (*a*) As to spelling.
   - (*b*) As to meaning.
   - (*c*) As to action.
2. Associate the words *union, unite, universe,* and *universal.*
3. Illustrate the action of gravitation by reference to cables, wires, and ropes.
4. How do gravity and gravitation differ from the other forces studied? (More universal; less specific; more easily overcome in special instances, yet never really ceasing to act; etc.)

Generalization:

Gravitation is the *universal attraction*, holding our Earth, as well as other heavenly bodies, in place.

APPLICATION:

Found in children's ability to comprehend the

NEBULAR HYPOTHESIS

LESSON VII

As any good Astronomy or even Encyclopedia will give the teacher the theory which Laplace and his followers advanced, it is here only outlined. The teacher will tell the story, making plain the fact of its being only theory, altho so long accepted that we begin to count it fact. Illumine the tale with as many illustrations and comparisons found in daily life as possible.

OUTLINE:

1. Universe of gaseous matter highly heated.
   a. Heat has overcome gravitation.
   b. Constant motion of these gases.
2. Mass gradually cools by radiation.
3. Gravitation regains power and some necessarily stronger particles of matter exert influence on weaker portions.
4. Gradual growth of these *centers* as more of the matter cools. We will follow one of these centers.
5. The continual movement, growing rotary, as each particle tries to reach the center of attraction. Spherical form generated. Compare with some games children play; with whirl-pools, whirlwinds, etc.
6. Motion becomes more and more accelerated. Centrifugal force begins to overcome gravitation.
7. Rings thrown off.
8. These rings drop behind, being further from center of attraction. Gradually they break up, as children have seen rings of smoke from a steam-engine break up.
9. The broken up rings begin to form into spheres (planets) still following the parent sphere (sun).
10. Each gaseous planet in the same manner throws off one or more rings which form smaller spheres (called moons) and follow their respective planets. Digress here to tell how some planets have several moons and how about Saturn some rings may still be seen, "left unfinished," Mitchell says, "to show us how the world was made."
11. After the original center has thrown off many rings it, too, begins to condense, giving both heat and light to all its "children."
12. Each process may have required thousands of years.

The teacher should follow the above with enough of the Earth's story to show the children how these gaseous bodies became the present planets. Taking the earth as the one most interesting to us, let us see how it assumed its present form.

1. Vapors of iron, zinc, lead, etc., etc., gradually cool to liquid state.

2. On this liquid sphere a crust begins to form, keeping the interior warm, but gradually radiating more and more heat. (Have you ever tested molasses candy put out to cool? Compare.) We have every reason to think the interior of our Earth still in a very heated state. (Enlarge upon this, if desirable).

3. As the crust grows thicker and cooler, it becomes firmer. The interior, however, still cooling, contracts more and more. Gravitation (or gravity, since we are now speaking of the Earth alone) draws the crust towards the center, but it, being too large, folds itself in ridges which we call mountains.

3. Atmosphere about planet all hazy and heated. Full of floating particles, beginning to harden. Sun's light shut out by haze.

4. Vapors of water finally condense and great rains fall. Air cleared, Sun's light seen.

5. Separation of land and water. Oceans and continents formed.

6. Water assists in volcanic action. Land rises and sinks. Confines of land and water continually changing.

7. Action of water begins to make soil.

8. Vegetable life comes.

9. Animal life comes, ending in

10. Man's creation.

See the Bible story and compare it step by step, remembering that in God's sight "a thousand years are but as a day."

ERRATA IN MARCH BULLETIN.

P. 36, last line: "d" should read 3, not being a sub-division under 2, as printed.

P. 42, seventh line from bottom: Should read, "Adhesion, of which solution is one form," instead of the single word, "Solution."

A WEEK IN THE MT. LASSEN AND CINDER CONE REGION OF NORTHERN CALIFORNIA

BY ELMER I. MILLER, STATE NORMAL SCHOOL, CHICO, CAL.

Lassen Peak and the volcanic ridge of which it is a part form the connecting link between the Sierra Nevadas of Northern California, and the Coast Range and Cascades, and help to separate the great interior basin from the head of the Sacramento valley. The highest point of the ridge is Mt. Lassen, a volcanic cone some 10,437 feet high, located in the geographical center of a volcanic region of nearly 12,000 square miles in area. It overlooks every other elevation in Northern California save Mt. Shasta, also volcanic, which is over 14,000 feet high and some distance to the northwest. The Lassen region is a part of the great lava field of the Northwest, which covers about 200,000 square miles. The number of vents in the vicinity of Mt. Lassen has been given by Diller as over 120; some of them are a mile in diameter. The whole elevation here is formed by the piling up of erupted material. The great majority of the peaks still show a distinct crater-like summit. The latest of the cones to be formed and also the most perfect is Cinder Cone. It is about ten miles northeast of Mt. Lassen and fourteen miles from Drake's Hot Spring Valley.

No description I can write or that I have read can give a perfect idea of this region. It must be seen to be fully understood. Yet, as the region is somewhat difficult of access and few have opportunity to visit it, a brief description, tho it be imperfect, may be of interest.

Cinder Cone is remarkable for its regularity and perfectly conical form. Only in the east and southeast is this regularity broken. It has a slope of from 30° to 37° and is composed of the loosest fragments, from the size of a pea to several inches in diameter, in many places giving the impression of an immense pile of cinders thrown out of a railway locomotive. Its height is 640 feet from the lowest point of the base, tho it has an elevation of 6,906 feet above sea level. Its average diameter is 2,000 feet at the base and 750 at the top; thus a regular frustum of a cone is formed. The crater is a regular inverted cone 240 feet deep and has an inner and outer rim. The cinders are of such a character as to preclude the possibility of plant life in any great amount. In fact, there seem to be only a few isolated plants (eriogonum) in or near the crater.

It was said above that the regularity of the crater was broken on the east and southeast. On the east side a ridge juts out and seems to have been a part of a very early lava flow; on its surface are a few stunted pines. On the southeast side there is a deep trough leading out from the base of the cone to the lava field. It is here that Diller says the lava stream which formed the lava field broke out thru the cone. From this it would follow that the cone had been formed at an earlier eruption than the lava. The nature of the materials shows the earlier eruption which formed the cone, to have been explosive, and the latter, which formed the lava field, quiescent. There are persons who think that Diller is wrong and that the lava eruption occurred before the cone was formed. To me, a layman, the conclusion of Diller seems to be justified by the surroundings. Those, who object to this theory, say the force necessary to push the lava out thru the side of the cone, would have been so great as to entirely disrupt the cone. That the force required was enormous, it only needs a look at the field to know; yet, it does not follow that the entire cone would have been destroyed. There are numerous instances of eruptions from the sides of volcanic cones which left the cone itself intact. Dr. Harkness of the California Academy of Sciences, (Proc. V, 408) says, the lava field was formed by upheaval in place and did not come out of the side of the cone. Diller shows that the line of movement can be distinctly traced in the lava to-day and that it has proceeded from the southeast side of the cone.

The lava field ends in an abrupt, almost perpendicular wall, in most places from 75 to 125 feet high. The surface is extremely rough and the rocks are very angular and jagged. The rock is of various colors; from very dark brown, almost black, to red. The north end of the flow reaches Lake Bidwell (named in honor of Mrs. Annie K. Bidwell, wife of Gen. John Bidwell, one of the early explorers of the region.) A part of the former bed of this lake was covered by the lava. To the southeast the lava, by forming a dam across the stream which formerly emptied into Lake Bidwell, has made a new lake known as Snag Lake. Once this latter lake had in it many old trunks of trees, so before the eruption of the lava, it must have been a piece of wooded land. Only a few of these snags now remain. Snag Lake has no visible outlet, but doubtless the water follows, more slowly than of old, its old channel either under the lava or thru it.

In a recent letter from Mrs. A. K. Bidwell, she says that her husband, the late General John Bidwell, and several guests visited Cinder Cone, on solicitation of a Mr. Hank Landt, a trapper, in June, 1873. Gen. Bidwell knew Mr. Landt well and considered him very reliable and truthful. Landt persuaded the party to make the trip from Big Meadows to Cinder Cone with himself and an Indian guide. Gen. Bidwell was assured by Mr. Landt that no white person save himself had before visited the region. The country was very wild and the Indians hostile. At the time of their visit there were many dead trees standing in Snag Lake. Mr. Landt declared the trees were alive when he had seen them last some winters before. He said a great noise had been heard in the region fifteen years before the time above mentioned, and that when he saw the cone, the lava field and the green trees in the lake, he concluded the noise had been connected with the eruption. If so, the eruption must have occurred about 1858. Mr. Landt also declared the lake was not there when he first visited the place. Gen. Bidwell, himself, thought the trees could not have been in the water to exceed fifteen years. When General and Mrs. Bidwell made a second visit in 1877, John Muir accompanied them. The trees had then disappeared from the lake, save under the edge of the lava dam where a few still protruded from the rocks.

In all directions from the cone for about eight miles extends the ash field. This field is composed of volcanic sand or ash thrown out of the cone in the eruption and scattered over the land without being greatly influenced by the wind for it is tolerably regularly distributed, tho of course the finer particles the winds carried to the greater distance. Near the cone the ash field is several feet in depth. Our guide said seven or eight, but as Diller found it to be nearly seven feet on an average at a distance of one-fourth mile from the cone, and since it diminishes in depth very rapidly as it recedes from the base, it seems certain the depth at the base of the cone is much more than seven or eight feet. It rapidly decreases until some eight miles away it almost disappears. This ash is very loose and like the cone itself makes walking very fatiguing. There is no evidence of volcanic dust; when the sand or ash disappears all evidence disappears. Most of this region immediately around the cone is entirely barren, tho it was covered with large forest trees before the eruption. Many old, charred stumps and trunks still remain. On some parts of the ash field, even tolerably near the cone, there are some pine trees of considerable size, apparently grown since the region cooled off after the eruption. A large area of the most distant parts of the ash field is covered with forest.

The question now comes how long ago did the last eruption take place. It is impossible to tell; but while the whole country bears evidence of newness, it seems likely we will have to give up the notion that there has been an eruption within the past half century. Diller thinks the cone to be not less than 200 and the lava field not less than 100 years old. The argument that Snag lake could not have been formed more than fifty years ago, because at a much later time than that the trees or snags standing in the water were well preserved is not at all conclusive. For it is known that such snags may stand in water for a very long time. Moreover the trees may not have been in water all the time since the eruption. Again new areas of land with living trees on them may have from time to time been submerged, thus adding new snags. For instance, there are islands in the lake on which living trees now stand. A slight rise in the lake which occurs nearly every spring would bring some of these trees into the water for a short time but not a long enough time to kill them. If this rise of lake level were to be permanent, it would cause snags of recent trees to appear standing in the water. Again, the outlet of the lake may have been clogged by various methods long after the lava had ceased to flow, and thus, the lake level rising, the water would have covered land over which it had not previously extended and on which were living trees.

The apparent newness as indicated by the smoothness of the cone, the absence of erosion and the character of the sand, may be deceiving, for on seeing some wagon and horse tracks in the sand and remarking that they looked as if they might have been there but a few weeks or months at most, our party was informed that they were made by surveyors six years ago. From this it is evident the sand does not shift about much; hence the appearance of newness does not prove conclusively that it is new. Dr. Harkness in the article above referred to and which is quoted approvingly by Captain C. E. Dutton[1] of the Geological Survey, puts the eruption in January, 1850. Dr. Harkness bases his belief, chiefly, on the statements of several persons living in the Northern Sacramento Valley and at Angels Camp, who reported having seen great lights in the direction of Cinder Cone at this time, and, on the reports of prospectors who claimed to have been in the region and to have seen the hot lava. All these statements are vouched for as being reliable. I am willing to confess to having attached much credence to these evidences until the past spring and summer, when not only newspapers but seemingly reliable persons, reported renewed volcanic activity in the region of Mt. Lassen. It was reported that "smoke" and vapor were seen rising from the summit of the mountain, that one day the summit was heavily covered with snow and the next was entirely bare, the snow having disappeared as tho brought in contact with a red hot furnace. (The snow was still there, however, when we visited the summit July 4, 1900.) Again, men reputed to be reliable, related that heavy, rumbling sounds had been distinctly heard at a considerable distance in the valleys below. So two men went into the region on snow shoes to see what was taking place. They found absolutely no evidence of unusual volcanic disturbance. Everything was much as it had been for years. When the snow had disappeared from the lower lands and the summer residents had entered the country they found the region as peaceful and undisturbed as before.

What was it that gave rise to the rumors of activity? Was there a genuine disturbance in the Mt.? Did some one start the story as a joke to see how many people would believe it, or was it hallucination or what? I do not pretend to answer. Neither do I wish to say that Dr. Harkness' evidence was of the same character; but I do say that evidence from persons the most trustworthy in ordinary life, needs to be taken with caution, where scientific accuracy of observation is required. Diller claims that some of the pines growing in the volcanic sand, thrown out when the cone was formed, are 200 years old as marked by rings of growth.

For the reasons above stated therefore the writer of this paper has come more and more to believe Diller right in putting the time of the latest eruption at much more than fifty years ago. In fact, it seems not unreasonable to suppose that the last eruption was not far from a century ago. And yet, even this may mean that the volcano is only dormant and not entirely extinct.

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[1] Science Vol. VI, 46.

There are no longer any signs of volcanic action in either Cinder Cone or Mt. Lassen proper. But there are abundant signs in the region of Drake's Hot Springs which, as has already been said, are fourteen miles from Cinder Cone and ten from Lassen. Here are hot springs, geysers, a boiling lake (Tartarus) and mud volcanoes of a mild type. Drake's Hot Spring valley presents several curious phenomena. It is several miles in length but comparatively narrow. Thru it flows a cold trout stream. on one side of which are springs of varying degrees of coldness, ranging from ordinary spring water to strong soda; on the other side within a few yards of one another are cold springs and springs so hot you cannot with safety put your finger in the water. Mr. Drake built a bath-house there and got his supply of hot water from one of these springs.

Up near the head of this valley is what is called the Devil's Kitchen. It seems well named, for it is a region of several acres of boiling, hissing, steaming, sulphur smelling springs, steam jets, and mud volcanoes. Parts of this area have ceased to show much activity and the most violent portions are around the sides of the depression which is surrounded on all sides by high bluffs. Much of the area is covered with mud, at some time thrown out by the springs, and now dried on top. This is, in fact, a dangerous place, for it bears all the appearance of being solid, yet being undermined by hot mud and water may break thru with the weight of a person. Several persons have been badly scalded in this way. The crust of dried mud is pierced by a great many vents for the escape of steam and other gases. Thru some of them steam only escapes; thru others both steam and water are ejected, tho there is nothing like a true geyser in the Devil's Kitchen; thru still others boiling hot mud either flows out as it is forced up by the steam from below, or is thrown out in small quantities by the eruptive force of the steam. The whole region bears evidence of having been much more active in the past than at present. There seems to be no doubt that the interior heat which is responsible for these hot springs is gradually but surely dying out. The conditions seem to point to these springs as the few remaining active evidences of the former intense heat of the whole region.

Somewhat downstream from the Devil's Kitchen and about one and one-half miles from the trout stream is Lake Tartarus or

Boiling lake. It is on the side of a ridge and is a deep hole of four or five acres area, around which are boiling springs and small mud volcanoes. Here and there thruout its area are places where the mud and water boil up and give a peculiar appearance to the lake. Sulphur fumes are strong here also. The lake has an outlet for high water. When dry in the summer its bed is very white due to the sulphur mud stirred up in the lake.

On the opposite side of the same ridge on which Boiling lake is situated, is what is know as the "Geyser." It is now only a vigorous boiling spring and seems to show no sign of a true geyser formation. The silicon deposits, necessary in the true geyser, are absent; there seems to be no tube built up, and there is no intermittent action. At the time of our visit the water was boiling up five or six inches and was regular in its action. Dr. Harkness says in 1874 it threw water to a height of ten feet, and that it was reported to have reached, at an earlier time, twenty or twenty-five feet. He does not say, however, that it was true geyser action. Some miles to the westward from Lake Tartarus are other hot springs. which like those in Hot Spring valley seem to be losing in intensity of heat.

These evidences of heat are all at some distance from the base of Mt. Lassen and indicate that the source of the heat is at a considerable depth. The surface of Mt. Lassen itself shows that the volcano has not been active for a very long time. At least it has been inactive long enough for glaciers to form on its sides and do much work of erosion. There are many other evidences, such as planed bed-rock and great depressions gouged out by the ice as it moved down the mountain. On the northeast slope of the mountain and to a less extent on the east, there are masses of perpetual snow almost reaching the form of true glaciers. These may or may not be the remnants of the glaciers that were so vigorously at work in earlier times.

A GREAT LAVA-FLOOD

BY JACQUES W. REDWAY, F. R. G. S.

The modern concept of a volcano, even among geologists, is apt to be somewhat short-sighted and misleading. Almost always the student is confronted with the assertion that a volcano is a mountain, etc. As a matter of fact, the essential feature of the volcano is just the opposite; it is a hole and not a hill. Careful, scholarly, and conscientious as Professor Prestwich is, he emphasizes and defines but one feature in the morphology of volcanoes, namely, the cinder-cone; the lava-dome and the lava-sheet are scarcely mentioned in connection with vulcanology. In American text-books the subject is treated with equal brevity: only one author, Doctor Joseph Le Conte, recognizes the many-sidedness of vulcanism. In a very brief chapter in his text-book on geology, and in one or two professional papers, Doctor Le Conte has probably said about as much on the subject as any other American authority.

It is not the intent of this brief article to discuss the morphology of volcanoes further than to say that three types of overflow may be recognized—the lava-dome, the cinder-cone, and the dyke with its consequent sheet. These types should be recognized, not because of any peculiarities of outline or contour, but because the products of eruption are marked by distinct characteristics, both chemical and physical. Thus lava eruptions from chimneys or vents, in the absence of steam or other gases, commonly build up domes—of which the Hawaiian volcanoes are a type. Eruptions in which steam, water, and non-aqueous gases are present are commonly marked by cinder-cones. Such eruptions are commonly explosive and may be designated as Vesuvian in type. Fissure eruptions are characterized by highly liquid lavas that in several instances have flooded vast areas; in others, a dyke, exposed by circumdenudation marks the site of an eruption. A modified form of the dyke possessing peculiar interest has been found by Mr. G.

K. Gilbert, in the western highlands of the United States, namely, the laccolites of the Henry mountains. These are nothing more nor less than volcanic blisters: the lava, instead of being forced to the surface, intruded itself between adjacent horizontal strata in the form of lenticular masses, lifting the overlying strata and leaving dome-shaped hills as a result.

There is a tendency among both geologists and geographers to look upon crater-eruptions as the type of vulcanism in all ages. This inference, however, is more than misleading: it is a serious error. In the more recent geological history of the United States, crater-eruptions as a rule have occurred only since later Tertiary times; prior to that, fissure-eruptions were the prevalent form. In very early times, however, there are evidences of crater-eruptions; and not a few old cones, buried beneath a débris of later deposits, have been subsequently exposed. The researches of Doctor Callaway in Shropshire have thrown much light on the ancient volcanoes of England; and at least a score of cones and domes have been discovered in the eastern United States. In a few instances—Mount Holyoke in Massachusetts, for example—the circumjacent material has been so extensively removed that a peak of considerable proportions remains.

The dykes and lava sheets resulting from the fissure-eruptions that occurred during Triassic and Jurassic times are so remarkable that they deserve to give a distinctive name to those periods. One of these, the famous Palisades of the Hudson river, is a dyke about a mile wide and forty miles long. It is important mainly as an obstacle to commerce: most of the railways approaching New York city reach the west bank of Hudson river by means of tunnels. Topographically, this dyke is a curiosity; it is a gigantic turn-pike or seawall traversing longitudinally a large arm of the sea, separating the latter into two bays.

But by far the most extraordinary fissure-eruption recorded in geologic history occurred in the western highlands of the United States during later Tertiary times. This outpour of lava began in the Sierra Nevada range somewhere near the 37th parallel. It originated not in one but in several fissures. The various lava-streams flowed northward in a roughly parallel direction, united in northern California in a single stream, and gradually formed a lake that covered the larger part of Oregon and Washington and a considerable area of Idaho. The northern edge of this irresistible flood extended nearly one hundred miles into British Columbia. For a time the channels of Columbia and Snake rivers were completely obliterated, and the waters of both were dammed in various places. It is by no means probable that these streams have recovered their original channels, but in a few places, however, it is quite certain that they have. The "Cascades" of the Columbia, and the "Dalles," as well, are nothing more nor less than tongues of lava that flowed across the stream. It is my own belief that these obstructions occurred at different, tho not at greatly distant times. Other geographers have expressed a contrary opinion, however, and perhaps the weight of authority is against mine.

The thickness of the lava-sheet of course varies greatly. The thinner crusts were doubtless soon destroyed but in many places isolated mesas occur, the lower caps of which are not more than twenty or thirty feet thick. The bold escarpments that form the rims of Crooked River cañon are perhaps two hundred feet. In various other places it is nearer five hundred feet. The vast plateau forming the "Plains of the Columbia" is a lake of lava and is of unknown depth. At the place where the Columbia river has cut its channel thru the lava, the latter is about three thousand feet in thickness! There is every reason to believe—in fact, it is quite certain—that the maximum thickness of the lake of lava, in places, is much greater. The streams that fed it, however, were comparatively shallow.

The surface of the lava streams was in each case more or less uneven; that of the lake was comparatively level. The flow, moreover, was marked not only by irregularity, but by numerous interruptions. Thus the cañon of Deschutes river is bordered here and there by bold walls more than two thousand feet high. In one place Doctor Le Conte counted thirty sheets successively imposed. A careful inspection and study of this same wall a few years previous to Doctor Le Conte's visit convinces me that he has underestimated rather than exaggerated the number. It is not necessary, however, to claim that these separate sheets were deposited at greatly distant intervals. Anyone who has observed the deportment of Hawaiian lavas—choosing their channels along the line of least resistance, building them higher than the surrounding surface, and then discarding them to make new ones to the one side or the other—can readily understand that moderately liquid lavas which part with their heat readily could not behave in any other way.

Years ago I endeavored to cross Crooked River cañon with two pack mules and a riding animal. There was no great difficulty in getting down the east bank to the flood-plain of the stream. It was a very steep descent largely among small fragments of lava, but there were no real obstacles; in fact, the descent in some places was too easy and too rapid for comfort. I camped by the river that night, and next morning began the ascent. By night I had got within two hundred feet of the top, but nothing short of a miracle apparently, would enable one to overcome the remaining distance. It was two hundred feet of vertical wall—the thickness of the upper sheet of lava—that not even a rocky mountain sheep could have scaled. That night my animals had scant feed. The following day I started down stream, keeping near the foot of the cliff, in hopes that I might find a lateral cañon. I found one that seemed to offer a way out but was compelled to give it up. Later in the day, I found another that seemed even more hopeless at first. In rounding a very steep slope of the cañon wall one of the pack mules lost her footing and rolled two thousand feet down into the river. Her pack contained all my provisions and all my ammunition except three cartridges. Inside the lateral ravine, however, the chances looked better and by dint of filling in a few places I succeeded in getting the remaining two animals to the top of the mesa. There was enough bunch grass for the animals, but there was nothing but a cold, supperless camp for myself. The following morning I tried to shoot a "cottontail" rabbit, but the cartridge exploded in the breech of the rifle and put an end to any further attempts at hunting and left me the other alternative of living on wild currants for the next three days.

The surface of this mesa was almost as level as a floor. The most remarkable feature about it was the fact that it was strewn with agates, most of which were "geodes." There were millions and millions of them; and I know of no way to account for their presence in that particular locality.

Another remarkable feature of the lava-covered region is the great number of craters scattered over it. Rarely do these exceed four hundred feet in diameter and the most of them are less than two hundred feet across. As a rule the crater walls are nearly vertical; in some instances, however, the sides are so irregular that a descent to the floor of the crater is not difficult. I climbed to the bottom of one of these; all traces of vulcanism had disappeared and there was not the slightest evidence of recent action. The most remarkable thing about it was a mass of ice on one side and some clusters of strawberries on the other; the time was August.

These craters, it should be observed, are not and were not centers from which the floods of lava issued; on the contrary, they are nothing more than vesicles parasitic upon the underlying lava. They were probably of no great duration, and many of them are wholly without cinder-cones. In themselves these craters possess no great interest; but the conditions of their origin point to an important fact, namely, that crater-eruptions are sometimes the offspring of fissure-eruptions, no matter whether the latter are intrusive or extrusive.

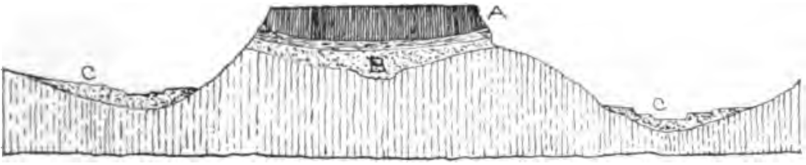


FIG. 1. SECTION ACROSS TABLE MOUNTAIN, CALIFORNIA.

Not the least interesting features of this and of similar eruptions that were approximately contemporaneous are the catastrophic results. The displacement of river-channels has already been mentioned. Some have been forever obliterated; in a few instances, however, the old channels of streams now existing have been discovered. One of these is shown in Figure 1. In this case, it is probable that two channels were formed in the place of the one obliterated. The mesa in question is the Table mountain of Tuolumne county, California, made famous by Mr. Bret Harte. In the figure, *A* is the lava cap, the surface of the mesa; *B* is the old bed and gravel deposits made by the former river; and *C*, *C*, the present river beds with underlying gravels. The earlier river gravels were reached by a tunnel and yielded an immense fortune in placer gold.

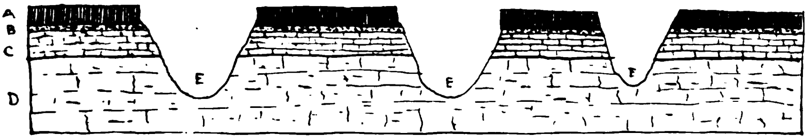


FIG. 2. THE DISINTEGRATION OF A LAVA CAP.
Sketched in John Day Valley, Oregon.

Figure 2 shows the manner in which the process of disintegration is taking place along the edges of the lava sheet. In this figure, *A* represents lava; *B*, volcanic ash; *C*, Tertiary strata; *D*, Cretaceous measures; and *E*, the results of corrasion. The form shown is not an uncommon one; and, at a distance, it makes a very impressive landscape.

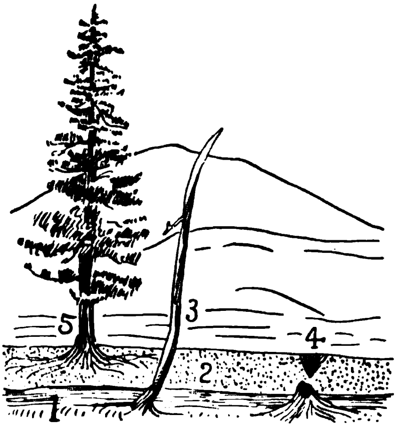


FIG. 3. RELATION OF THE OLD TO THE NEW FOREST.

As might be surmised, buried forests are an interesting feature of the catastrophic results of the lava-flood. Just how much of the area inundated was covered with forestry will never be known, but many circumstances lead to the conclusion that a very large area was timber covered. In one place where the Columbia river has cut its channel thru the lava sheet, a mass of buried forestry has been exposed and is now some feet above the water's level. Semi-charred trunks and roots in abundance are visible and in some localities constitute a jam twelve or fifteen feet in thickness. Most of the trees engulfed by the lava-flood are conifers, and, as a rule, the wood is in a fair state of preservation. Buried timber drifts are no unusual thing in this region, however, and they are by no means contemporaneous. At the Robinson mine, near Placerville, California, two such drifts were encountered, one many feet below the other. In one the timber was petrified; in the other, it was in its natural condition. Both drifts were situated in the auriferous gravels. Mr. Diller of the United States Geological Survey has described a comparatively recent eruption that occurred near Lassen Peak less than two hundred years ago. The *ejecta* from a small cinder-cone filled a valley, dammed a river, and pooled its waters, thereby making Snag lake. The eruptive matter was most likely a volcanic "ash" which hardened into a rather friable "cement;" it covers the valley in the form of a thin sheet. In places the charred trunks and stumps of an earlier forest protrude thru the volcanic matter and are still in a fair state of preservation. The accompanying figure (U. S. Geological Survey—Diller) shows the relations of an old forest to the new forest. 1 is the original soil; 2, volcanic ashes;

3, a tree of the former forest killed by the shower of volcanic ashes about two hundred years ago; 4, a pit formed by the decay of an old stump; and 5, a tree of the present forest. The volcanic *ejecta* readily disintegrate, forming an excellent soil; and a vigorous growth of young forestry is establishing itself on the top of the volcanic detritus. It is a queer circumstance but the country is brim full of just such curiosities.

THE INFLUENCE OF UNDERLYING ROCKS ON THE CHARACTER OF THE VEGETATION

BY HENRY C. COWLES, THE UNIVERSITY OF CHICAGO

INTRODUCTION: THE CHEMISTRY AND PHYSICS OF SOILS

It is a matter of common observation that different soils have different plants. Everyone expects to see a change in the natural forest covering, as he passes from one soil to another. For example in many parts of the United States pines and oaks are found in sandy soil, while maples and beeches are found on the clay. So true is this that in many places a bird's-eye view of the forest is sufficient to indicate the nature of the soil. One may go even farther; in many places it is possible to tell the nature of the rock by means of the trees that grow above it. This implies, of course, that the residual soil which arises thru rock decay varies with the character of the rock from which it comes.

So interesting is the subject just mentioned that it is well to cite examples. East of Port Jervis, N. Y., the Erie railway crosses Kittatinny or Shawangunk mountain. A fault line causes the Hudson river slates (Ordovician) of the east side to abut upon the Oneida conglomerates and red Medina sandstones (Silurian) of the west side. A traveler passes suddenly from the rich farm lands overlying the Hudson river slates to the barren and rocky slopes of the red sandstones. The slates erode readily, giving a rich soil, while the reverse is true of the sandstone. Along the Louisville and Nashville railway near Lebanon, Ky., there is a striking difference shown between the fertile lands of the blue grass region toward the northeast and the hilly and rocky districts toward the southwest along Muldraugh's hill. The railway runs for miles at the base of this hill, and one can scarcely imagine a greater difference than that which is presented from the car windows on the two sides of the train. These vegetation differences are associated with rock differences analogous to those noted in connection with Kittatinny mountain. Many similar instances in Europe have long been famous; for example in the Kyffhäuser mountains the Rothliegende (Lower Permian) strata are overlain by sparse heath floras while the Zechstein (Upper Permian) is overlain by beech forests. Of course differences of this character to be significant must be in regions where the soil is derived from the underlying rocks. In the glaciated districts of the northern states the soil has commonly been deposited thru the action of ice or water, and it is only where there are rock outcrops that the influence of the rock on plant life can be studied. In the southern Alleghanies, however, and in most unglaciated upland the rock is directly responsible for the overlying soil and hence for its vegetation.

Many years ago Sadebeck performed an interesting series of experiments upon some plants whose natural habitats are very limited. The European *Asplenium Serpentini* and *A. adulterinum*, grow normally on serpentine rocks. When grown for six generations in soil devoid of serpentine elements, especially magnesian silicates, these "species" changed respectively into *Asplenium Adiantum nigrum* and *A. viride*, common ferns of wider life range. Hence it is likely that the species first mentioned were derived from those last named and acquired their so-called specific characters from growing on serpentine rocks. In a similar way it is likely that the European zinc violet, *Viola calaminaria*, is but a special form of the common *Viola lutea*. Kerner has listed a large number of closely related parallel species, one growing on the calcareous Alps, the other of the pair growing on the siliceous Alps. He found that the forms of calcareous rocks differed from those of the siliceous rocks somewhat uniformly, having a greater development of hairs or glaucous coats, more divided leaves and larger corollas. Thus it may be concluded that rocks not only differ as to the character of their vegetation, but that new "species" are developed in various rock habitats.

For more than half a century plant geographers have debated as to the cause of the phenomena noted in the preceding paragraphs. Some have maintained that the facts are to be explained by the chemical nature of the soil. Others have argued for a physical explanation. It may be well to outline in brief something as to the history of this prolonged discussion. More detailed treatments of this subject may be found in the plant geographies of Warming or Schimper. One of the first sponsors for the chemical theory was the famous German botanist, Unger, who published as long ago as 1836 a paper on soil influences which must forever remain as a classic. Indeed this paper may be regarded as one of the first outlooks into the field which is now known as plant ecology, that phase of botany which deals with plants in relation to their surroundings. Unger called attention to the differences between the plants of siliceous and calcareous soils. He explained this phenomenon by supposing that plants had different chemical relations with soil elements; what is a foodstuff for one plant is a poison for another. Hence the absence of certain species from certain soils is to be explained by the absence of necessary food materials in that soil or else by the presence of deleterious substances. Of course a large number of species were found to be indifferent.

In contrast to the above theory, which has had a wide acceptance especially among the French botanists, there is the physical theory for which Thurmann contended as long ago as 1849. Thurmann and others who have espoused his views have regarded soil structure as more important than soil chemistry, and especially since it is the physical structure of the soil which in large measure determines the water and heat relations. Thurmann divided rocks into eugeogenous, which weather easily, and dysgeogenous, which weather with difficulty. The first class gives rise to a fine or pelogenous soil, the second class to a coarse or psammogenous soil. The fine soils hold water well and support a luxuriant vegetation, whereas coarse soils are dry and the vegetation is desert-like.

Ever since the days of Unger and Thurmann the conflict between the chemical and physical schools has waxed severe, tho in recent years the subject has been debated with less ardor than of old. The chemical theory seems to be favored by the phenomena exhibited by the salt plants or halophytes, since regardless of other conditions it is found that but few species can grow in salty soils, and it is noticed that these few species resemble desert plants in structure, whether water is abundant or not. The influence of calcareous soils is less marked, and yet the European botanists have listed a number of species that are said to avoid such soils, e. g. lichens, heather, chestnuts, etc. Fertilizers have marked effects, as is well known, nitrates favoring some plants, potassium salts others, phosphates still others. One of the most marked instances of the chemical effects of soils is seen in humus plants; nearly all common plants grow much better in a rich humus soil than in other conditions, because of the plentiful supply of foodstuffs. The physical theory is favored, as Warming has so ably shown, by the influence of soil water. Most of the fine gradations between plant societies, he thinks are due to fine gradations in the supply of moisture. In the successive zones about a pond, each zone has a change in the plant species following a change in the water content of the soil. The transformations that come when a dry area is irrigated are well known and this phenomenon furnishes a striking argument in favor of the physical theory. For example a dry, sandy area properly irrigated can be made to support the same plants as a clay area without much irrigation. Warming in summing up the results of the conflict in 1895 concluded that there was truth in both theories, but that the physical theory was quantitatively more important, and especially because of its influence on the water relation of the soil. As a consequence Warming has given out an essentially physical classification of plant societies, dividing them into three main groups: hydrophytes or water plants, xerophytes or plants of dry soil, and mesophytes or plants of intermediate water relations. In a fourth class, halophytes or salt plants, he recognizes the dominance of chemical influences.

In the later years, as noted above, the discussion of physical and chemical theories has become less and less acrimonious. This is doubtless due, among other things, to a growing appreciation of the fact that the line between chemical and physical influences cannot be sharply drawn. Nearly all of the study on soil influences has assumed either a physical or chemical influence where it has not been experimentally proven. The halophytes form an excellent case in point; altho salt plants have been all but universally instanced as illustrations of the influence of chemical factors, it may yet be proven that it is a physical rather than a chemical property of the salts which is detrimental to the activity of so many plants. Indeed it is suggested by recent studies that the osmotic properties of the soil solutions may be found to be the chief cause of halophytic structures. This subject has been but slightly investigated, and all that can be said at present is that the halophytes as a chemical class must be distinctly challenged. Vallot and Schimper show that chemical and physical properties are mutually related to one another, and that a change in the one is accompanied by a change in the other, and that one cannot say offhand which factor dominates.

Another reason for less acrimonious debate now than formerly is the growing recognition of the fact that the contrasts between the floras of different soils have been largely overdrawn. In other words the problem is not so much to explain contrasts between calcareous and siliceous or between pelogenous and psammogenous soils as to explain resemblances. The very groundwork of the debate, then, has been or is being removed. Some lines of thought that were neglected by the earlier workers will now be recounted.

Blytt, DeCandolle and other students long ago called attention to the fact that close observation for many years in a region rich in various rock types would result in eliminating most of the so-called siliceous and calcareous plants, and that most plants would be found on most soils. Even in the few exceptions to this rule a study conducted over the entire area occupied by a species would show that it grows naturally in most soils. As an instance of this there may be cited the European beech, which is reported to be a siliceous plant in southern Europe and a calcareous plant in Denmark. Indeed, Blytt observes that a number of siliceous plants have their northernmost limit in Norway on calcareous soils.

A second neglected factor was mentioned by Nägeli in 1872, viz., the struggle for existence. It was his belief that the severe competition for place was the chief cause of the so-called preference of a particular plant for any special soil. If a pine grows naturally in the sand and a beech in the clay it is not to be inferred without experiment that either tree could not grow successfully in the other soil. As practical gardeners well know, there are plants that grow well in some soils and grow poorly in others; yet the fact that plants from all soils and many climates grow and thrive side by side in identical soil in botanical gardens shows that there are more plants indifferent as to soil than there are plants that require any particular soil. In nature these plants do not grow side by side because in the natural struggle for existence some survive while others perish. It is even true that many plants grow best in soils in which they are rarely found in nature—this is notoriously true of many of the weeds growing in the hard soil of roadsides. The common doorweed (*Polygonum aviculare*) grows everywhere in hard soil, yet it grows much better in rich garden soil; it is all but confined to roadsides and dooryards, because the better conditions elsewhere are pre-empted by other plants. We may say then that while most plants appear to be obligate, they are in reality facultative, so far as soil is concerned.

A third factor which has often been neglected is the relation between the rock and the soil which comes from it. It is often assumed that a calcareous rock gives rise to a calcareous soil, just as a siliceous rock gives rise to a siliceous soil. As a matter of fact, practically all rocks give rise to siliceous soils. This would be expected of granites, sandstones or shales, but it is equally true of limestone or dolomite. Indeed the per cent of silica is sometimes greater in a soil derived from limestone or dolomite than in a soil derived from a siliceous rock. One may generalize as follows: mechanical erosion results in a soil resembling the original rock, while chemical erosion, which involves the solution and removal of the soluble ingredients, gives rise to a soil differing radically from the parent rock. These facts are well brought out in a table of soil analyses, published by the State Agricultural Experiment Station at Knoxville, Tenn.

	SILICA. Per Cent.	ALUMINA. Per Cent.	IRON. Per Cent.	LIME. Per Cent.	MAGNESIA. Per Cent.
Sandstone................	88.7	4.1	1.5	.06	.18
Shale........................	82.9	6.	2.7	.16	.44
Dolomite..................	87.8	4.6	1.7	.055	.175
Limestone................	82.3	5.7	2.5	.27	.31

In this table the approximate equality of the silica in widely divergent rocks is very noteworthy. The small amount of lime in the limestone soil and of lime and magnesia in the dolomite (magnesian limestone) soil is almost startling. In this connection it is important to use extreme caution in the interpretation of phenomena in glaciated regions, since much of the soil overlying rocks is likely to be drift rather than residual soil.

A fourth neglected factor, which seems to the author of greater importance than all the others combined, is the physiographic or historical factor. Whatever the kind of rock, as will be shown later, the initial plants and plant conditions will be much the same and the ultimate plants and conditions exactly the same. In other words exposed rocks of all kinds have much the same floras; so too when centuries have passed and the rocks are buried underneath a rich humus soil, the conditions will be the same everywhere and the plants, under similar climatic conditions, will be the same. If a sand hill or a clay hill, a granite hill or a limestone hill, have different floras, it is not because of differences in the rock nor of the inorganic soil which comes from it, but it is because one is farther along in its life history than is the other. The vegetation that a clay hill has today will be seen on a sand hill in the future centuries. One may sum up these facts as follows: the vegetation of all hills in a given region, of whatever chemical or physical nature, is tending toward an ultimate common destiny, which in most parts of the United States is the mesophytic forest. The succession of plant societies is sometimes slow and sometimes fast, and hence we have at any given period before the ultimate stage is reached a

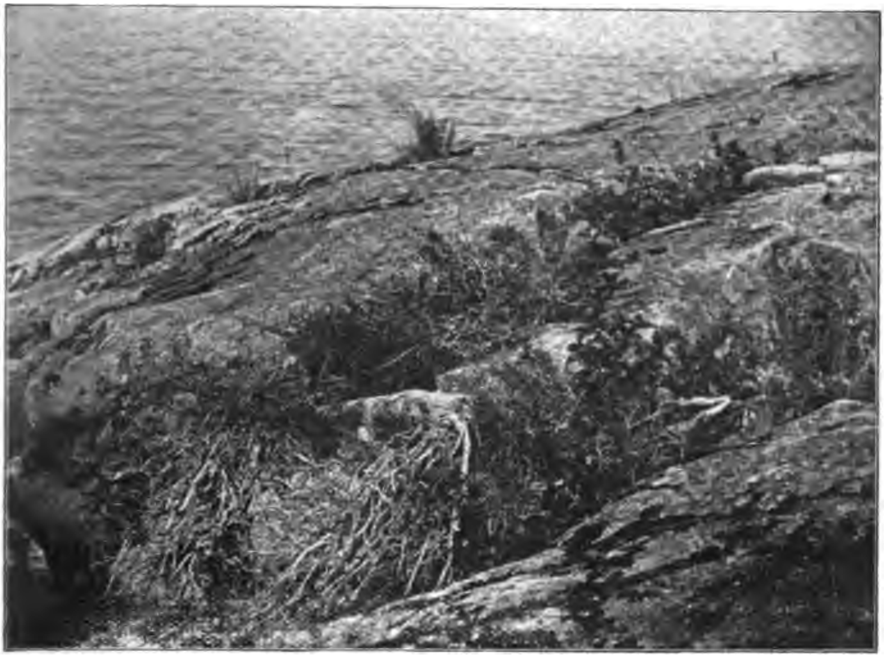


FIG. 1. Granite island at Marquette, Mich., showing lichen patches on the otherwise bare rock, mosses in the small crevices, and various herbs and shrubs in the deep crevices.

difference in the vegetation on different rocks and soils. Were the stages equally rapid in all cases, there would be no such differences and we should have been spared the acrimonious debates of the past half century.

The materials for this paper have been gathered by the author during the past four years in various parts of the eastern United States. The principal localities studied were (1) the Lake Superior region about Marquette with its magnificent outcrops of granites, schists, serpentines, diorites, quartzites, sandstones, and iron rocks; (2) the Alleghanies of eastern Tennessee with splendid outcrops of sandstones, shales, limestones, dolomites, and coal rocks; (3) northern Illinois and eastern Iowa with their sandstones, limestones, and dolomites; (4) Connecticut with its granites, gneisses, basalts, and sandstones. Less satisfactory studies have been made of the limestones, shales and sandstones of northern Ohio, the limestones and sandstones of Pennsylvania, Virginia, and West Virginia, and the limestones of northeastern Wisconsin. Much of this work has been done in connection with various students to whom the author wishes to make grateful acknowledgment. The photographs with which the paper is illustrated were taken by Mr. W. B. McCallum, except in a few instances where proper credit is given in the legend.

THE ROCKS AND THEIR VEGETATION

I. Granitic rocks. The flora of granitic rocks has been studied in the Lake Superior region and in Connecticut, and the stages in the life history of the rock vegetation have been made out with considerable ease in spite of the fact that both regions studied were glaciated. There are several good reasons for starting the discussion with the granites; perhaps the best of these reasons is that all the typical stages are well developed on these rocks. On many rocks some of these stages are eliminated.

The nature and duration of the granite plant societies are due chiefly to two features connected with the erosion of granite rocks, first that it is slow, second that it is differential. The resistance of granite to processes of weathering is well known, and the idea which many have of "everlasting hills" is often derived from granite. Quartz, which makes up a large part of most granites, is singularly resistant to the chemical forces of erosion. The other elements, especially the felspars, are more easily attacked, and as a result the rock surface becomes etched; the depressions represent the position of the felspars or other more soluble constituents, while the elevations represent the quartz or other less soluble constituents.

The first plants to get a foothold on granitic rocks are commonly lichens. These interesting plants vary exceedingly in general form: those which adhere so closely to the surface on which they grow as to appear embedded in it are called crustaceous lichens, those which are leaf-like and attached by evident root-like rhizoids are called foliaceous lichens, while those that are erect and branched are called fruticose lichens. The crustaceous lichens are the first to appear on bare rock surfaces; and hence they may be regarded as the pioneers of vegetation, altho foliaceous lichens are rarely absent even in the earlier stages. Lichens are wonderfully

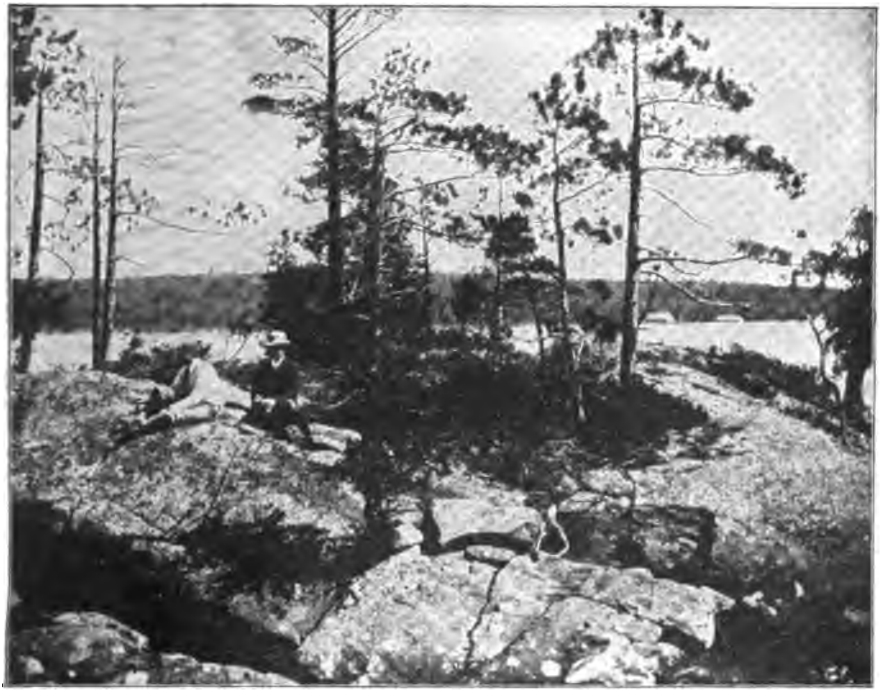


FIG. 2. Granite island at Marquette, Mich., farther advanced than the island shown in fig. 1. Lichen patches in the foreground. Norway pines in the deeper crevices.

adapted to rock life, since they can attach themselves readily to bare rock surfaces—here comes in the significance of differential erosion, for the reproductive organs find lodgment in the depressions thus created. The growing plant sends out its organs of attachment and doubtless aids chemically in rock erosion by the substances which it exudes. Again lichens require practically no soil, but are able to get all of their food from the air or from the rock itself. Finally lichens are the most pronounced of xerophytes and are able to endure long periods of drought without injury. Among the more prominent of the foliaceous lichens at Marquette are *Parmelia*, which is so common everywhere on fences and trees, and the rock tripe, *Umbilicaria*. Figures 1 and 2 show granite surfaces partially covered by crustaceous and foliaceous lichens. The granite conditions may be summed up thus in a sentence: the lichens come early because the erosion is differential, they stay late because the erosion is slow. Therefore exposed granitic rocks are usually well covered with lichens, perhaps more than in most rock types, because of the long time which they can enjoy for their development.

The continuation of differential erosion more and more accentuates the differences between the elevations and depressions. Dust and sand collect in the hollows; and lichens, by their decay, contribute to the formation of a soil. An opportunity is now given for a higher type of life than the crustaceous or foliaceous lichens, viz., a type whose members are rooted in the soil. Most commonly surface rocks are fissured and jointed so that crevice plants can make their appearance contemporaneously with the lichens above mentioned. However the crevice stage may be regarded as the second phase in the development of rock vegetation. Among the pioneer crevice plants are such mosses as *Ceratodon*, *Polytrichum*, and *Funaria* and fruticose lichens, especially the reindeer lichen, *Cladonia rangiferina* (see figure 4). With or soon after these forms are some plants higher in the scale, such as the harebell (*Campanula rotundifolia*), the mouse-ear everlasting (*Antennaria plantaginifolia*), one of the cinquefoils (*Potentilla tridentata*), and xerophytic ferns (*Woodsia Ilvensis*, *Polypodium vulgare*, *Selaginella rupestris*). This list was made out at Marquette, and yet nearly all the plants mentioned except the cinquefoil would be found in rock crevices over most of the eastern United States. In comparing this second stage with the first rock stage, the most striking difference is found in the addition of a soil to furnish food materials to the vegetation. Again the opportunities for the development of holdfast organs are much better in crevices than on bare rock. The xerophytic character of the habitat, however, is scarcely less striking than on the bare rock itself. Fig. 1 shows crevice plants, especially mosses; the lines of moss plants are quite in contrast to the irregular patches of lichens.

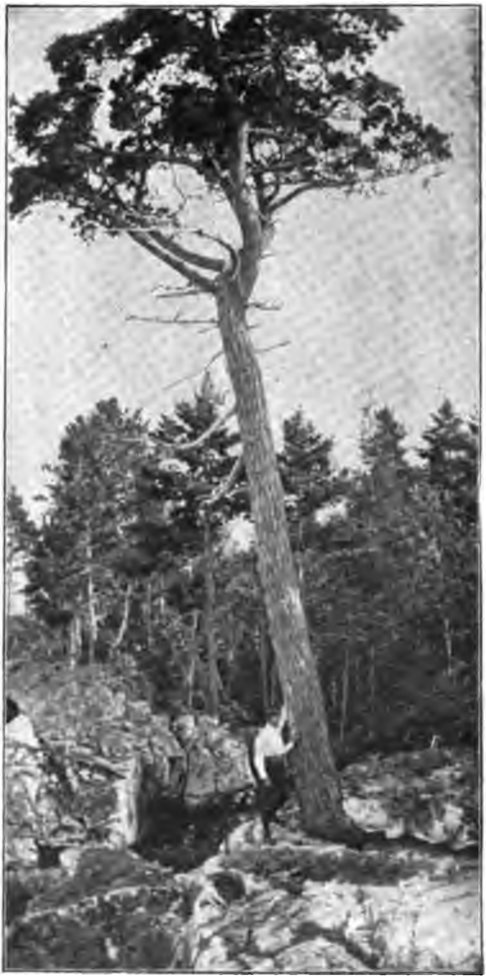


FIG. 3. Crevice in granite rocks at Marquette, Mich., with a Norway pine, showing how trees contribute to rock fracture. Pines in the background—the beginning of a forest on the granite.

The first and second stages show an interesting variation when the rocks are near the water level. For example, in Fig. 1, the stages are as noted above on the parts of the island above the reach of the waves. Within the reach of the waves, however, there are to be found zones, reminding of the zones on a beach. Just above the water line where waves wash frequently there are no plants, the habitat being too often exposed to allow water plants, and too often washed by waves to allow land plants. This first zone is the exact equivalent of the plantless lower beach. Then comes a zone in which mosses grow in the crevices; and finally there is a third zone in which the normal conditions are found, viz., lichens on the bare rock, mosses and other plants in the crevices

It is thus seen that within the reach of waves, mosses are the pioneers rather than lichens—mosses may be almost as xerophytic as lichens, but lichens are less hydrophytic than mosses.

The continuation of differential erosion and the increased development of crevice plants cause constant additions to the crevice soil. Opportunities are thus given to those plants that require more soil for food materials and more place for holdfast organs—among these plants, shrubs and small trees play the most important part. With the advent of shade-giving plants there enter essentially new conditions; moisture is conserved and humus is more rapidly accumulated. As a result not only in the crevices but also where the rock was bare a soil comes to be built up. This phenomenon is illustrated in the accompanying cuts. Fig. 1 shows crevice shrubs; Fig. 2 illustrates an older stage with crevice trees (Norway pines); while Fig. 4 represents a stage in which bare rock can be no longer seen, and yet the reindeer lichen shows where the rock was bare while the trees locate the crevices. Fig. 3 indicates another way in which these processes are hastened, showing a Norway pine growing in a crevice and causing its enlargement year by by year. When one considers that the roots penetrate into every nook and cranny, it can be seen that the rock-splitting function of roots is no inconsequential matter. When the more favorable conditions appear as outlined above, a change takes place in the dominating tree species for two reasons. In the first place the shade may be too dense to permit the germination and development of the seedlings of the tree species present. For example, pines are often the first crevice trees, but pine seedlings cannot develop in the shade created by a dense growth of pines. Again, increasing shade and moisture make conditions that favor new tree species, such as maples. So for one reason or another there is a succession of tree stages on the rock hills, the first forms being xerophytic, while those which follow become more and more mesophytic as the centuries pass. There is a natural culmination of these processes, and perhaps the beech comes as near as any to the final species in many parts of the United States.

The development of successive forest stages on granite hills is finely shown near Marquette, both on Sugar Loaf peak and on various islands. Perhaps the dominant member of the xerophytic tree stage is the Norway pine, *Pinus resinosa*, shown in Figs. 2 and 3. Other trees of this stage are the scrub pine (*Pinus Banksiana*), the arbor vitæ (*Thuya occidentalis*), the aspens, (*Populus tremuloides* and *grandidentata*), the wild red cherry (*Prunus Pennsylvanica*), the paper birch (*Betula papyrifera*), and the service berry (*Amelanchier Canadensis*). Characteristic shrubs are the dwarf blueberry (*Vaccinium Pennsylvanicum*), the bearberry (*Arctostaphylos*), *Diervilla*, *Rosa Engelmanni*, *Cornus circinata*, the juniper (*Juniperus communis*), and nine-bark (*Physocarpus*). On one of the islands there was found the beginning of a mesophytic forest. Some of the plants that indicated this were the sugar maple (*Acer saccharinum*), which is the surest sign of mesophytic conditions in the Marquette region; the flowering raspberry

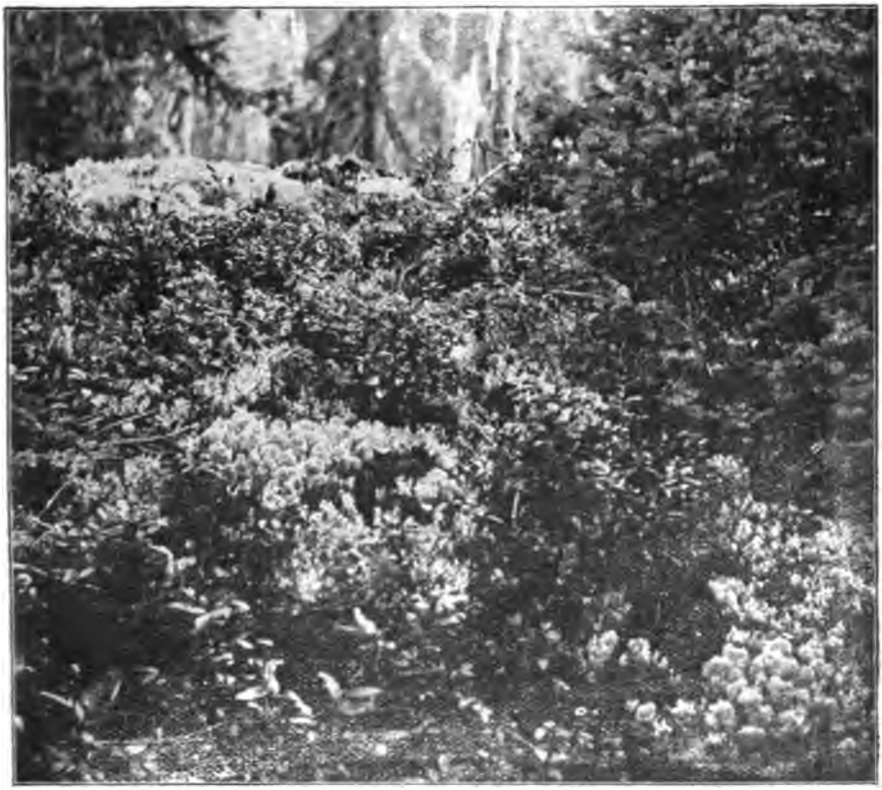


FIG. 4. Granite rocks at Marquette, Mich., entirely overgrown. The once bare surface is indicated by the white patches of reindeer lichen, the crevices by the trees.

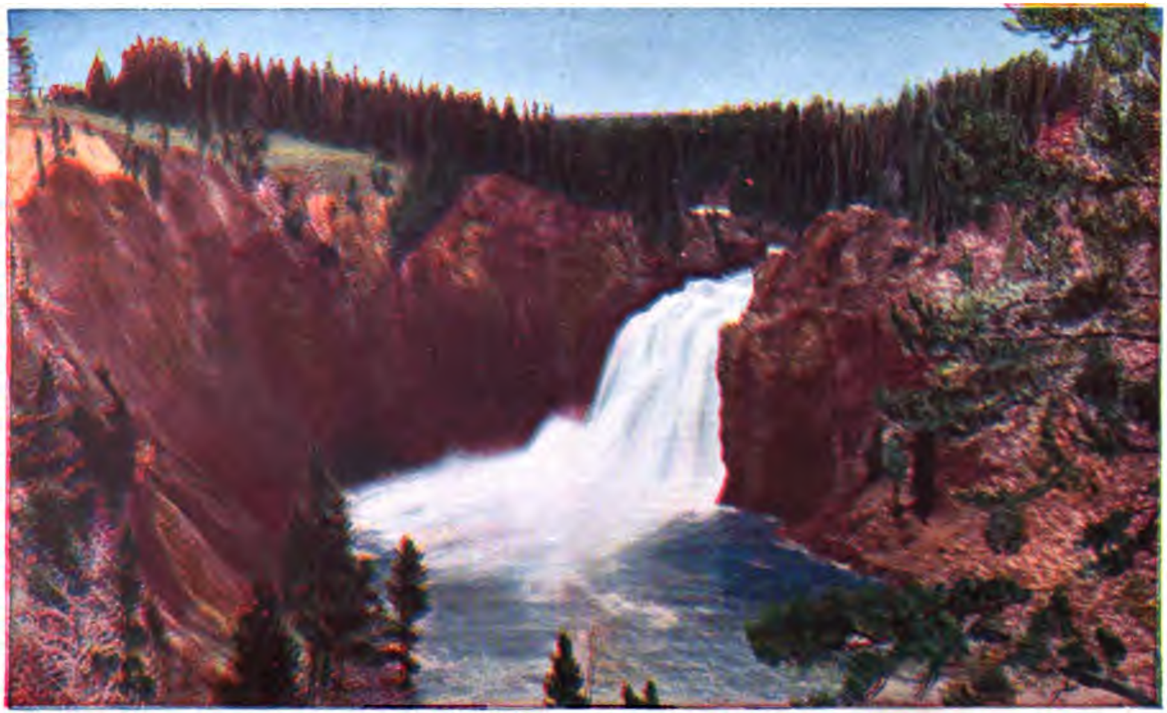
(*Rubus odoratus*), and *Clintonia borealis*. The soil here may have been morainic in part, but it nevertheless shows the possibilities on granitic rocks.

Very interesting successive stages were seen along the coast near Norwalk, Conn., where granitic islands rise out of salt marshes. On the younger islands the rock is bare and shrubs or trees are found only in the crevices—among these early forms are the red cedar (*Juniperus Virginiana*), and the bayberry (*Myrica cerifera*). Other crevice plants are the silvery cinquefoil (*Potentilla argentea*), the poison ivy (*Rhus Toxicodendron*), and the Virginia creeper (*Ampelopsis*). Older islands showed a dominance of oaks and pines; the pitch pine (*Pinus rigida*), the white, post, and black oaks (*Quercus alba, stellata,* and *tinctoria*). Junipers and bayberries are still present, but the bearberry and huckleberry (*Gaylussacia resinosa*) are added. The oldest island seen, showed a marked change in the flora; the pines were all but gone, the white oak was still present, but the hickory (*Carya*) equaled it in dominance. The chestnut (*Castanea*) was also present. This flora is less mesophytic than the maple forests of Marquette but it marks a great change from the origi[illegible] rock conditions. Here as at Marquette some of the soil [illegible] glacial drift, yet the stages are the same as if the soil were [illegible].

From the instances cited, it may be seen that granite hills, slow as the progress may be, nevertheless furnish a favorable position for the development of all the stages in the life history of a mesophytic forest; given time enough, one may then confidently predict that where granite hills now are, there will sometime be a mesophytic forest, if the climate is such as to favor it.

(To be continued)

THE NEW YO



UPPER FALLS OF THE YELLOWSTONE, 115 FEET.

THE PIRACY OF THE YELLOWSTONE*

BY JOHN PAUL GOODE

Ever since the Grand Canyon of the Yellowstone was introduced to the general public, it has enjoyed a well-deserved fame for its grandeur and for the unrivaled beauty of its coloring. To the physiographer it has stood as a type pre-eminent of a very young river valley in the trench stage of development. All who have seen it have been profoundly impressed by it, and by many it is considered the most satisfying object of beauty in the region. It is now possible to introduce this already famous canyon in a new light, as the scene of one of the greatest acts of piracy on record.

The Yellowstone lake, with an altitude of 7741 feet A. T., lies in a depression in the southeastern part of the great rhyolite plateau of the Yellowstone National Park. On the east of the lake the land rises rapidly to the high crests of the Absaroka range. On the north and west, and for the most part on the south, the land rises to the general level of the plateau, eight hundred to a thousand feet above the lake. North and south of the lake, and fringing the west shore, are considerable areas of flat land, not far above the present lake level and plainly lacustrine in origin.

The long southeast arm of the lake is seen to be the lower end of a magnificent mountain valley, here submerged. Beyond the lake the valley extends over thirty miles to the southeast, past the limits of the Park, up into the heart of the Absarokas. The upper Yellowstone river occupies this broad vale, at present wandering on a gradient which compels it to constant deposition, the flat bottom of aggraded material averaging over a mile in width for twenty miles southeast of the lake. This valley is manifestly very old,

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*Readers of the Bulletin contemplating a visit to Yellowstone Park will find this article of special interest. It is reprinted from the *Journal of Geology*, University of Chicago, thru the courtesy of Professor T. C. Chamberlain. The Bureau is indebted to Mr. D. B. Burley, Salt Lake City, Utah, for the accompanying half-tone illustrations. They have been selected from the attractive publication, *Where Gush the Geysers*, issued by the Oregon Short Line Railroad, the new Yellowstone Park Route via Monida.

and it has its counterpart in the Lamar valley in the northeastern part of the Park. It has been shown[1] that both these valleys were old and well developed before the rhyolites were poured out to form the Park plateau in Pliocene time. The lower courses of both these valleys are masked by the rhyolite flows, and the lake depression itself may be suspected to be a great mountain valley obstructed by lava flows.

The divide west of the lake lies on the flat-topped rhyolite plateau, and at various places there are cols of significant shape and altitude. Plainly some of them have been lines of drainage, showing that at some time water has flowed across the divide, making well-defined valleys. The stage road from the Upper Geyser basin to the "Thumb," as the west arm of the lake is locally called, passes thru one of these notches at the continental divide east of de Lacy creek. It is rather a narrow valley, with walls perhaps a hundred feet high, cut right across the crest of the divide, yet flat-bottomed and at present marshy and undrained.

It is believed that this whole region has been covered with ice moving west from the Absarokas and north from the Tetons; and it may easily be supposed that in the unequal recession of the ice margin, obstructed drainage would give rise to overflow to the west, establishing channels that would be abandoned on a further recession of the ice. But there is one such channel which gives evidence of very long use even after the ice had left the plateau. This is a "windgap" between Overlook and Channel mountains at *D* in the map, page 179. Here a canyon with walls several hundred feet high cuts across the present divide, down almost to the contour of 7900 feet. Yet this surprising notch is poorly drained, puny streams starting from the marshy col and flowing to opposite oceans. The eastern one is an unnamed branch of Grouse creek, the one to the west, called Outlet creek, leads into the Heart Lake basin and so south to the Snake river. This notch has been recognized as a former outlet of the lake, and the fact is well known that the lake was once at this altitude, about 160 feet above its present level. Lacustrine deposits are recorded on the United States Geological Survey maps,[2] practically up to the 7900-foot contour, all around the lake, and at its foot to a point four miles below the present lake outlet, at Thistle Creek canyon, marked *T. C.* on

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[1] ARNOLD HAGUE: The Age of the Igneous Rocks of the Yellowstone National Park. Am. Jour. Sci., 1896, I, p. 454.

[2] Yellowstone National Park Folio, U. S. Geol. Surv., Washington 1896.

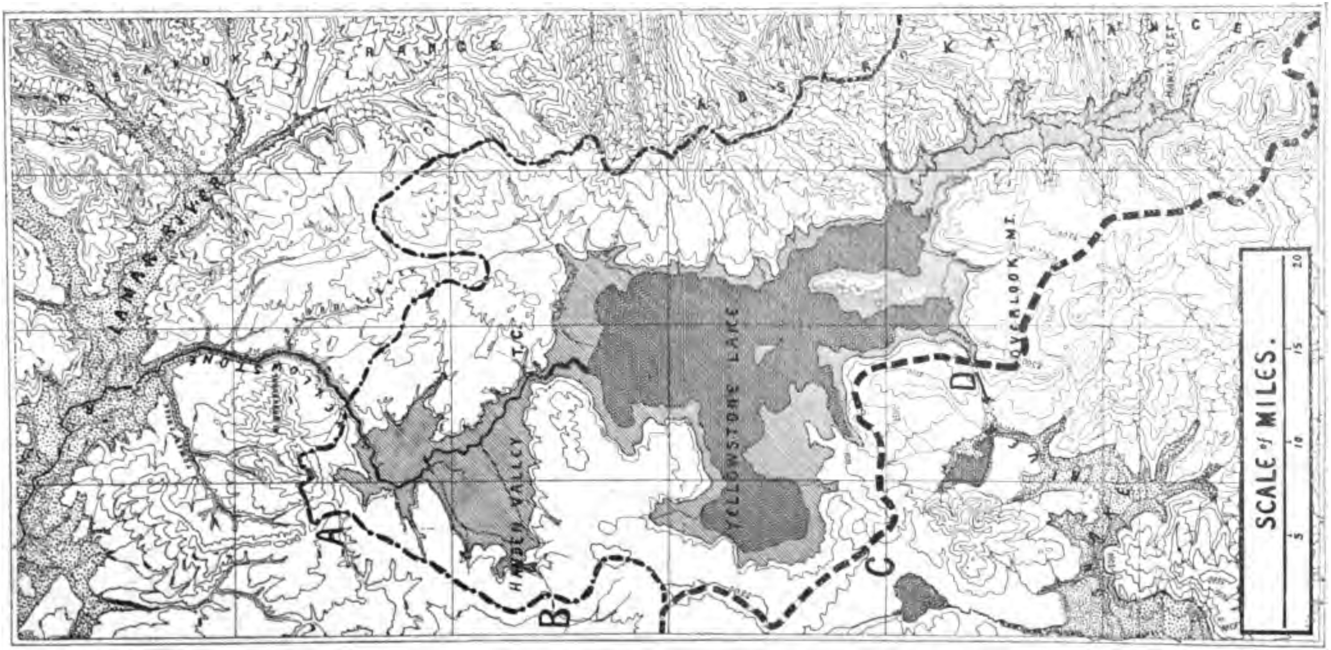

FIG. 1. Map of the eastern part of the Yellowstone National Park. The heavy dotted line *C D* is the present continental divide, the lighter line *B A* the ancient divide. The heavy hachured areas are present lakes, light hachured area is the ancient lake.

the map, page 179. At this level also are found terraces, old sea cliffs and beaches, and while other shore phenomena are found at lower levels, as, for example, at the sixty-foot level, yet in some respects the most strongly marked records are at the higher level.

Thru the Thistle creek narrows to the north, the country flattens down into the Hayden valley—a triangular depression in the plateau, ten miles east and west by seven or eight miles north and south. The surface of this depression is covered largely with moraine deposits of glacial drift, and all round this valley, particularly in the drift, the hills show a significant profile, which, immediately below the Thistle Creek canyon, is undoubtedly terrace and sea cliff. On the upper courses of Trout creek, and across the river east of Crater hills, similar profiles are seen. The central portion of Hayden valley is a very flat plain, extending along the two streams, Alum and Trout creeks. These two streams are wandering on a very low gradient, Trout creek showing as beautiful an example of oxbows on a small scale as may be found anywhere; and in its wandering, its valley walls show stratified clays, the fresh-cut bank in one place near the roadway standing at a height of over thirty feet against the stream. (Fig. 2, *A*, *B*).

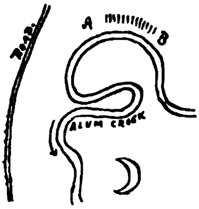

FIG. 2

At the Grand canyon the strongest impression one gets is that the canyon is extremely young, that the river is still actively corrading at bottom, and the walls all along are actively sloughing, by every process of degradation. Yet this impression of youth has its greatest emphasis, only when seen from the east flank of Mt. Washburne. Here, at an elevation of about two thousand feet above the plateau, the whole eighteen miles of canyon is in view, from the Falls to Junction Butte, dwarfed now by distance into a simple roadside ditch. With this view, it is easy to see that the canyon is not all the same age. The north half of it is distinctly older than the south or upper half. In the north half the shoulders are markedly rounded, the walls less steep, the stream at bottom has long ago found an axial equilibrium with the material it has to handle, and is not deepening or widening its bed in any striking way. It is a surprise to notice, too, that Broad creek, which empties into the Yellowstone river just at the east foot of Mt. Washburne, has a canyon every whit as wide, as deep, and with shoulders as rounded as has the main canyon at this point.

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Pl 2

GRAND CANYON FROM THE BRINK.

One cannot help wondering why the Yellowstone canyon is so young only above this point; why the deep stratified clays in Hayden valley; why the terrace and cliffs at the high level in Hayden valley. Why did the Yellowstone lake abandon a good outlet at Overlook mountain, and flow off to the north? The explanation may be read from the correlation of the available data as follows:

GRAND CANYON FROM GRAND VIEW

"The strongest impression one gets is that the canyon is extremely young."

The Yellowstone canyon for five miles or so below the falls is extremely young, the occupation by the river representing only a fraction of postglacial time. On the recession of the ice from the region, the plateau of rhyolite stretched untouched by the river action, from the south base of Mt. Washburne southeast across the site of the present canyon, at the general plateau level of about eight thousand feet. There was no canyon, and no Yellowstone river there. The two depressions in the plateau, Hayden valley and the present lake basin, if they existed in preglacial time, outflowed by some other route, at present unknown. On the recession of the ice from the region, these basins overflowed to the west, over available cols. Possibilities of such drainage lines, besides the one mentioned on the road to the "Thumb," may be suspected at *A*, *B*, *C*, and *D*, on the map, Fig. 1. But the one which established itself for greatest permanence was the one described at Overlook mountain.

Now taking the topographic map and supplying a shore line for a lake outflowing at this channel, the surprising fact is shown that such a lake not only pushes itself into the great valley over sixteen miles to the southeast, but it goes on thru the narrows at Thistle creek, on the very level of the terrace and sea cliff noted. It covers all the Hayden valley, with the exception of the very peaks of Crater hills, and extends on past the falls and the Canyon hotel to Inspiration Point, thus making a great twin lake extending over fifty-one miles from Inspiration Point on the north to Hawk's Rest far down into the Absarokas on the southeast. This greater lake is shown on the map by the lighter shaded area. The darker shade showing the area of the present lake.

The only assumption necessary in this reconstruction, is the absence of any considerable crustal deformation in postglacial time, and so far as known there is no evidence of any appreciable change of this kind in the area during this time.

Let us look now at the character of the Grand canyon as it appears among its neighbors. The dominant topographic feature of the northeast part of the park is the great Lamar valley. It is over two thousand feet deep, and its walls have receded under the tooth of time until a broad and generous vale a mile and more in width at bottom extends for twenty-five miles above the point of its confluence with the Yellowstone river. This vale was old in the Pliocene. It was deep and of generous size before the rhyolites and basalts were poured out to mask the old drainage and make the plateau in which the Yellowstone lake and canyon now lie. Once see this great valley and the impression is inevitable that the Yellowstone canyon is a very late comer. Moreover, as a canyon it is not of much more importance than its neigbor of Tower creek on the west. In short, the Yellowstone canyon, from Junction Butte back to the east flank of Mt. Washburne, is not the work of the Yellowstone river at all, but was made by Broad creek, then a small tributary of the Lamar, of no more consequence than Tower creek, which joined it from the west. Its canyon may have been begun in preglacial time, but long after the general ice-sheet had left the region it remained an obscure stream, slowly pushing its growing gorge back into the rhyolite of the plateau.

In Fig. 3 the site of the future Grand canyon is represented, the contours being copied from the United States Geological Survey topographic map, with the exception that south from the mouth of the present Broad creek the contours of Broad creek itself are supplied, in the line of drainage of Sulfur creek. The col between the Sulfur creek gorge and the greater lake lay about two miles north of Inspiration Point in the old Continental divide. Yet the Sulfur creek pirate was a long time eating thru this two miles or so of barrier. And all this while—a good fraction of postglacial time—

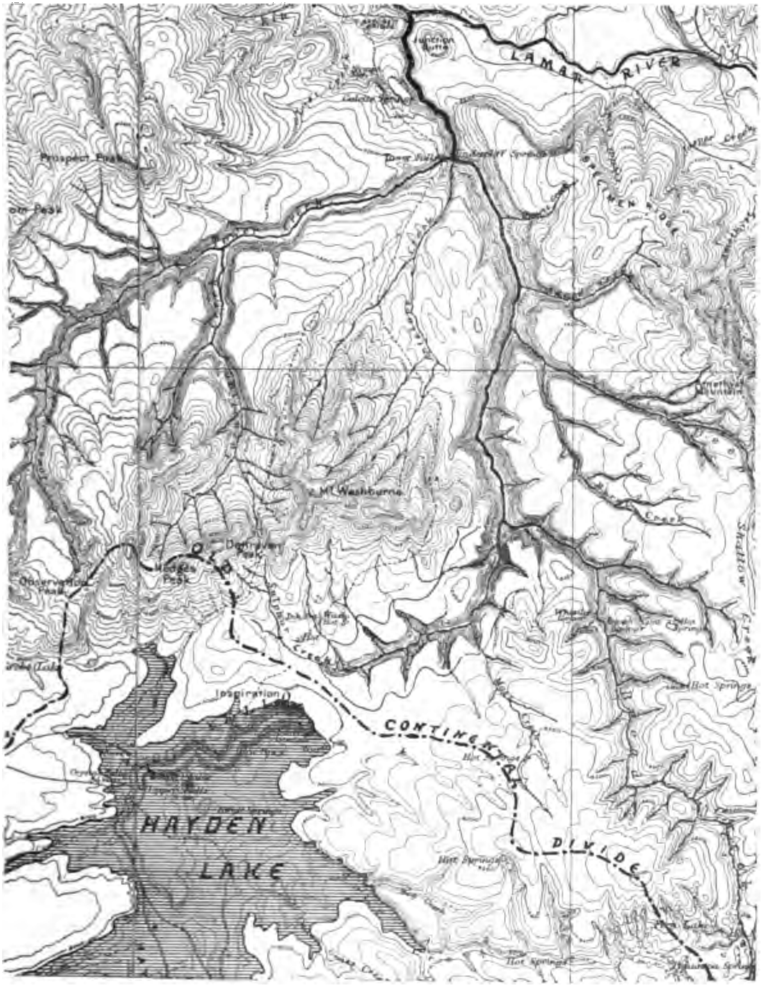


FIG. 3. Map of the scene of the piracy, showing relative size of the canyons of Tower creek and Broad creek. The contours of Broad creek canyon are supplied in place of the upper half of the present Yellowstone canyon.

the great lake was giving its water thru the Overlook mountain channel to the Snake river, and the beaches, terraces, and sea cliffs were building at the contour of 7900 feet—about 160 feet above the present lake level. In the Hayden valley part of the lake, similar beach records were making, and the stratified clays were being deposited off-shore.

The rate of advance thru the col by the Sulfur creek pirate would depend upon three factors, the volume and gradient of the stream, and the nature of the rhyolite. The volume of water was not large, being only the drainage from the south flank of Mt. Washburne and the east flank of Dunraven peak. The gradient was high, about 1500 feet, in the Sulfur creek branch alone, while the rhyolite in the path of the canyon was in admirable condition for easy working.

HAYDEN VALLEY BETWEEN LAKE AND FALLS.

The rhyolite, on first cooling from its flow, was hard and firm of texture, the obsidian or volcanic glass being one phase of it, usually found at the surface. In deeper levels it may have been as hard and crystalline as basalt; but the hot vapors from below have attacked the firm rock and in many places totally changed its character, making the felspars over into kaolin and leaving the once firm lava a crumbling mass, almost like slaked lime. Yet this solfataric action has not been universal. It has worked very effectively in certain areas, while in other places the solid rhyolite has wholly escaped the decomposing action. Were this not so, the canyon would long ago have advanced clear to the present lake.

The trend of physiographic history in the region was suddenly changed when the col was cut thru by the advancing canyon. The water of the lake began to flow out to the north, the increased volume very greatly hastening the deepening and widening of the trench. The lake level was rapidly lowered, the Overlook mountain outlet was suddenly abandoned, and with this change the continental divide was transferred to its present position south of the lake. The lowering of the lake level was extremely rapid for a hundred feet, while the outlet was cutting in the decomposed rhyolite merely. In the hundred feet of rapid lowering but slight traces of shore action on the lake could be expected. But this rapid lowering was checked when the river reached the 7800-foot contour, for it came upon a wall of firm, undecomposed rhyolite standing squarely across its path—the site of the present Great Falls—and the river settled down to the task of sawing this barrier in two. It is still at the task, with nearly a quarter of its work yet to do. This barrier is only about a hundred feet thick, and is very plainly marked in the brow of the canyon wall, forming a narrow gateway thru which the water rushes. The inner walls of this gateway are very precipitous, as may be seen in the familiar view of the Great Falls. Immediately above and below this gateway, the canyon walls fall away to a wide V-shape in section. The plan, Fig. 4, shows the relation of the barrier to this fall, and how the canyon is narrowed to the precipitous gateway in the barrier.

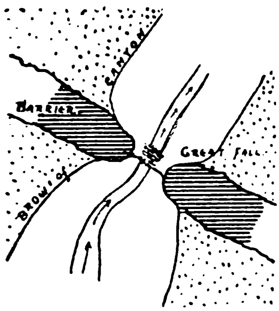
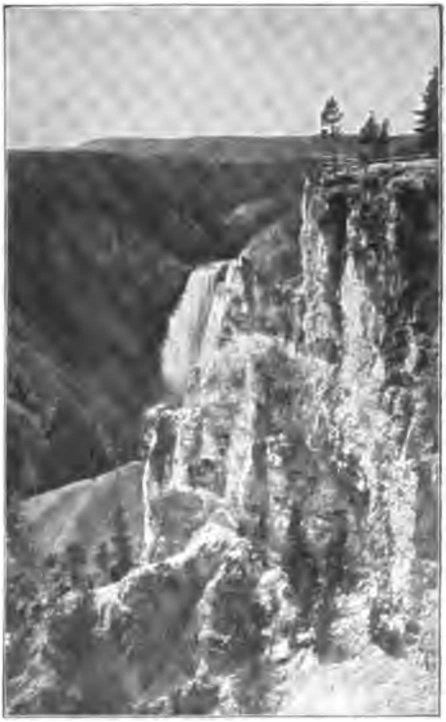


FIG. 4. Diagram of the barrier at the great fall.



GREAT FALLS OF THE YELLOWSTONE
"It is still at its task, with a quarter of its work yet to do."

As seen from the downstream side, this barrier is evidently cut down a little over half its height, and one may easily conjecture that this fall, which is now 312 feet high, must have earlier been much higher, perhaps even seven hundred feet. The present brow of the fall is near the up-stream face of the barrier, and standing at the brow one may see that the firm rock of the barrier projects at the bottom on the east side of the stream, as a shelving ledge upon which the water is ceaselessly pounding, as shown in longitudinal section in Fig. 5. So this fall may be said to be showing signs of old age—that is, the rapids phase of development has already begun.

With the lake outlet approaching this barrier at the contour of 7800 feet a current was formed at the Thistle creek narrows, and two separate lakes resulted, with a short river between. The lower lake covering Hayden valley, we may provisionally call Hayden lake. The river at the narrows had glacial drift only to work on and was competent to cut this out widely as Hayden lake level followed the lowering brow of the falls.

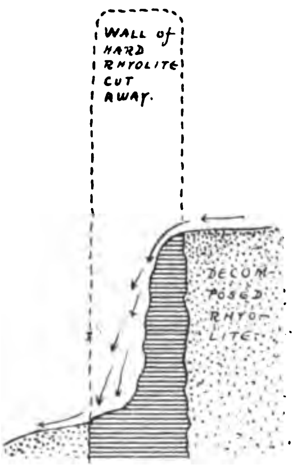


FIG. 5. Longitudinal diagrammatic section of the great fall.

The problem was made more complex when the river discovered another wall of firm rhyolite at the site of the Upper Fall. This wall is much thicker than the lower one, and the process of cutting is proportionally slower. It was the lowering of this barrier which determined the lowering of Hayden lake level. When the wall was cut somewhat below the 7700-foot contour, Hayden lake was drained, and this has only very recently been accomplished, as is shown by the flat and sinuous course of Trout creek.

The wearing down of the barrier at the Upper Fallh as always lagged behind that of the lower. It could not be touched at all, until the lower barrier was reduced below its level, and the height of the Upper Fall has always been limited at its lower level, by the brow of the Lower Fall. The Upper Fall has increased in height almost uniformly with the decrease in height of the Lower Fall, and it is plain to be seen, that when the Lower Fall has finally sawed thru its barrier, the river will carry the canyon gradient back to the Upper Fall which will then be perhaps four hundred feet high.

With the lowering of these two barriers, other barriers were uncovered in the path of the stream above. The most important of these is a ridge of firm rhyolite in the bottom of the Thistle creek narrows. This became a large factor in the history of the Yellowstone lake, when in the cutting of the canyon at this point, this firm rhyolite was reached, at a level about sixty feet above the present lake. The lake level since then has waited on the lowering of this one barrier. It is the only barrier which now determines the lake level, altho it seems plausible that in earlier stages, a barrier at Mud geyser, and perhaps even the Upper Fall barrier, were agents also in maintaining the lake at the sixty-foot terrace, the action on each barrier being much deferred by the lack of gradient due to the former higher elevation of these lower barriers.

This is the postglacial history of Yellowstone lake and canyon as it may be read from the data in hand. The whole great lake, with its drainage basin of about fifteen hundred square miles, was captured by the little Sulfur creek canyon, taken bodily from the Snake river and the Pacific slope, and added to the Lamar river and the Atlantic slope. And the volume of water in the captive stream was so great as to dominate the lower valley of the Lamar, and reduce that older stream to the rank of a minor tributary.

EDITORIAL

Suggestions to Teachers

One of the best ways to review a country is to compare it constantly with the home country or with some country already studied.

Teachers can find much valuable material and many useful ideas by visiting museums and great exhibitions. Every teacher who did not go to the World's Fair at Chicago, owes it to herself and her pupils to spend two or three weeks this summer at the Buffalo Pan-American Exposition. There geography will be taught by the object lesson method. The teachers of Buffalo will take care of such visitors after they get there. Send for circular to the Teachers' Pan-Tourist Co., 433 Mooney-Brisbane Building, Buffalo, N. Y. This organization is endorsed by such persons as Dr. McMurry of Columbia College and Mr. Emerson, Superintendent of Schools in Buffalo.

Query:—Can *new* concepts be taught to children by means of the moulding board, by models or by maps?

Would not children be more likely to become interested in geography if the study began with something they can comprehend, something they can see near their home?

It seems to me it is time for educators to protest against the *excessive* use of pictures in text-books. Certain primers have been published lately in which more space is given to illustrations than to reading matter! A new elementary geography has just been shown to me in which I judge more than one-half of the space consists of pictures. There are scores of pages containing groups of ten or more pictures. So much grouping is all wrong because it is confusing to both teacher and pupils. In some geographies the pictures are too small to be effective.

In school text-books should not the pictures be subordinate to the text and help to explain the same? Who ever saw a novel in which the pictures exceeded the text. Is there not something for the child in school besides amusement? Children need to be trained to read pictures as well as maps. Too many pictures distract the mind, weaken the attention to the main purpose and leave little for the imagination. Too many pictures in a geography for instance is as bad for the child as too few. Is not the proportion of one-third space for pictures to two-thirds space for text about correct?

The summer vacation is a good time to work up exchanges of material.

The Boston Geographical Club meets the first Monday evening of eight months in the year to listen to papers upon scientific and practical subjects. Prof. Elizabeth Fisher of Wellesley College has been the energetic president for two years. Under her persuasive rule much has been accomplished to improve the teaching of geography among the members. What members of this Bureau will organize clubs in their own cities?

If you are at Buffalo this summer, hunt up the great twelve-foot Model of Boston and vicinity. This model was made by the state of Massachusetts for the Paris Exposition and was justly praised for its size and accuracy.

What an immense amount of geography can be taught around these central points—a cold country, a warm country.

Be out doors this coming vacation with nature, breathing the pure air, becoming well tanned in the bright sun, growing strong and hearty for the new year's nervous strain. C. F. K.

The New Geography

The conventional geography of twenty-five years ago, introduced the subject with a series of definitions of coast, relief, stream, and other features. This method imparted little real knowledge and developed less power. For what child could possibly recognize a real cape from its definition as a point of land extending into the water, or a mountain from its definition as a high elevation of land, or ever more than arbitrarily distinguish between a plain and a plateau? Following the introductory definition came a jumble of facts each series having no cause and effect relation with any other series. Little attempt was made at correlation and consequently the several sections or departments of geography presented no coherence, had no illuminating thread of interdependence running thru them connecting one department of the subject with another.

But beginning with Darwin's travels, with Wallace's explorations, with Bates' work on the Amazon, and with Agassiz, Humboldt, Ritter, and Guyot, geographers began to realize that if geography is to be made an interesting and inspiring branch of science in the public schools, each series of facts must bear some essential relation to other series. Each fact must be made to fit its place in a complex whole whose sole aim must be to give organized knowledge and develop power. In these respects, modern geography is rapidly winning a place as a science. Not only is it systematized and organized knowledge, it also has for its basic idea the study of environments. It treats the earth as the home of man but recognizes that the earth contains many environments, some of which are favorable while others are unfavorable to man's progress and industrial development.

In consequence of the changed attitude of geographers, the truths of modern geography are no longer expressed wholly in cut and dried definitions, but endeavor is made to trace the origin of the relief forms of land as well as of all features pertaining to coasts, streams and the sea. Geographers now explain in a clear and convincing way how coastal plains have originated and pass by slow processes from one stage of development to another, at each becoming more complex. They show how regions pass thru periods of growth, from youth to maturity and finally to old age, and after old age occasionally to rejuvenation. Each stage of growth presents a certain character of environment, the influence of which upon life and industry presents an interesting and instructive field of study.

Again, modern geography furnishes a necessary introduction in our public schools to science, which now is a dominant factor in the civilization of the world. This becomes evident when we consider that geography deals chiefly with four topics, viz., structure, climate, life, and people. But the study of the structural environment leads directly to the sciences of geology and mineralogy; the study of the climatic environment leads to the science of meteorology; the study of life in geography culminates in the study of biology, botany, and zoology; while the simple geographical studies of people by school children furnishes a necessary introduction to ethnology, ethnography and kindred subjects relating to man.

It becomes evident that the modern geography teacher's training must be broad and his knowledge of a number of sciences exact. His reading, too, must be wide and varied, and every available resource for field study be laid under contribution. For this reason such special magazines as the Journal of School Geography, the National Geographic Magazine and the Bulletin should be in every teachers hands. These keep him in touch with the latest methods of research and presentation as well as the freshest thought of the best geographers. H. J. R.

Patagonia

The blank appearance of the maps of less explored portions of the earth tends to give to the young student of descriptive geography the idea that these regions are physically undifferentiated, perhaps in proportion as they are little known. And while the error is a manifest one even to the very young, it is not always easy to eradicate it, or, what is more important, to prevent its formation in the pupil's mind. Hence the value to the teacher of geography of keeping as closely as possible in touch with the main results, at least of recent travel, investigation and discovery in order to supplement the maps and text-book descriptions. For instance Patagonia has been until very recently a *terra incognita* and its geography has been accordingly very briefly told. A cold climate, a barren, inhospitable land inhabited by barbarous men of unusual stature, were the main features stated in text-books of no distant date, the stature of the inhabitants being presumably based on the sailor yarns of Magellan, who claimed to find men of six to nine English cubits in height. But the explorations of the past few years made chiefly under the auspices of Princeton university have done much towards making known the more important geographical features of the southern extremity of the American continent.

A recent contribution to the physiography of the region, that is well worthy of the attention of teachers of geography is "The Lake System of Southern Patagonia," by J. B. Hatcher in the *American Geologist*, for March, 1901, (single number, 35 cents, Prof. N. H. Winchell, editor, Minneapolis, Minn.) In this article which is illustrated by a map, the numerous lakes of the far south are classified according to origin as residual, glacial, and tectonic.

The first, which are all salt lakes, are shown by an interesting series of observations to have been formed by the enclosing of portions of the ocean consequent on the elevation of the land above sea level. Only small or intermittent streams flow into them; those near the sea are as highly saline as those far inland; and approaching the Atlantic coast from the interior they are found in all stages of formation. Salt beds are formed in the earlier stages when the lakes are cut off from the ocean except at spring tides, or even less frequently, in the intervals between which the water would be more readily evaporated. In the final stages the drainage of surface water into them alone prevents their completely drying up and thus passing into salinas. The salt deposits are such as to give the lakes considerable economic importance.

The glacial lakes occur near the eastern foot hills of the Andes to the west of the region of the salt lakes, where glacial material has dammed the drainage from the mountains. They often have no surface outlet, yet their waters are quite fresh. Lagoona Blanca and Cardiel are the largest.

The lakes of tectonic origin, which are also fresh, are far the most important in area. They lie between the central and the eastern of the three main ranges of the Andes, yet all but two are drained into the Pacific. While none of these lakes have been as yet fully explored, many are known to be from fifty to one hundred miles in length and, except on the east side, to be generally surrounded by lofty mountains, from which glaciers extend, sometimes to the water's edge, when icebergs of considerable dimensions break off and float out into the lakes, Argentino, Viedma, San Martin, Pueyrredon, and Buenos Aires are amongst the largest. The lakes of this class are due to the uplift of the eastern or later range of the Andes, across the previously existing valleys of drainage from the older ranges on the west J. A. D.

REVIEWS

The International Geography.—By Seventy Authors, edited by Hugh Robert Mill; 8vo., 1088 p , 488 illustrations, 1900. D. Appleton & Co., New York.

Books of multi-authorship are often disappointing, but this one is proving a very notable exception. All the authors are specialists in geographic science and each writes upon the subject in which he is an authority. The skillful editorial work of Dr. Mill, moreover, has produced—not a collection of fragments, but a well-rounded unit. A part of the work is devoted to the general principles of geography; the great bulk of the volume however, is descriptive of the peoples and the countries of the world. As a book of reference to the general reader, it is better and more practical than the cyclopedia and far superior to the ordinary gazetteer; it is not only better written, but the material itself is better selected. For the teacher in search of a better and fuller preparation for the geographic work of the schoolroom, nothing that has appeared during the past twenty-five years equals it. One might sum it up as the correlation of geographic principles and facts. The teacher who owns this volume together with Mr. John Fiske's *Discovery of America* has a very comprehensive and complete geographic library. J. W. REDWAY.

A Text-Book of Geology.—By A. P. Brigham; 12 mo., 8-477 p., 1901. D. Appleton & Co , New York.

This volume is the latest one in the series of *Twentieth Century Text-Books*, and is a worthy addition to the collection. It is a treatment of the subject, intended for secondary schools, in which technical terms and discussions have been largely avoided. Considerably more than half the space is given over to dynamical and structural geology, in which the point of view in treatment is that of the physiographer. This is the best part of the book, and is strictly modern in conception and treatment. The first seven chapters will be found very valuable for auxiliary reading in physiography classes. Parts of the treatment of rivers have never been better done.

In Part III, Historical Geology, no attempt has been made at fullness; but a simple statement of the progress of life, and the growth of the lands thru the ages has been creditably carried out.

A strong feature in this series of texts, and one which invites the highest commendation, is the fine quality of the illustrations. Most of them are half tones from the original photographs, and of a quality so fine, that any one may be copied into a lantern slide with excellent satisfaction. One may make better slides from these prints than many that are on the market. The taking screen is ruled so fine that the eye almost fails to resolve the rulings, and the etching is so admirably done, that no tooling is required. The press work and the paper, too, are fine, and give the engraver credit for the good work he has done.

J. PAUL GOODE.

Elementary Meteorology.—For high schools and colleges. By Frank Waldo, Ph. D., late junior professor in United States Signal Service. Small octavo vol., cloth bound, 1896. Price $1.50. American Book Co., Publishers, New York.

Meteorology or the science of the weather comprises the study and systematic consideration of the varied and oftentimes intricate phenomena of the atmosphere, their influence or bearing upon weather and climate, the natural laws by which they are governed, and their relations to each other. It is in many respects a young science, for tho the invention of the thermometer dates from the end of the sixteenth century, and that of the barometer from the year 1643, meteorology as a separate science may be said to have originated at the beginning of the nineteenth century. From this period of time date the first systematic observations and trustworthy records of the weather. The weather instruments named, the thermometer and the barometer, constitute the chief means for observing accurately some of the more important conditions and changes which occur in the atmosphere, namely those of temperature and pressure.

Taken in the broadest sense, the science of meteorology is closely affiliated with many of the natural sciences, namely with chemistry, hydrostatics, aerodynamics, heat, electricity, optics, geology, and with both mathematical and physical geography. One must know the rudiments and main facts of all these in order to be able to understand the composition of the atmosphere, its physical conditions and the laws governing the motion of air; the formation of mist, fog, and clouds; the various forms of precipitation like rain, hail, snow, and sleet; the electric and optic phenomena like lightning, thunder, coronæ, halos, and auroræ boreales; the motion of air resulting in trade winds or monsoons, cyclones, hurricanes, typhoons, and many other phenomena.

Meteorology cannot to-day claim the distinction of an exact science, tho it is sure to reach this position as our knowledge of the vast atmospheric ocean surrounding the globe gradually increases. As yet our knowledge of weather and climate extends over but a small part of the sphere; and vast areas of the earth's surface and particularly of the oceans are still comparatively unknown to us.

In its more practical application the science of the weather is one of universal interest, for not only does nearly every business and profession come more or less into contact with it, but much of our work and of our enjoyments of life depend upon it. The work of the modern scientific meteorologist finds a useful application to agriculture, to commerce, transportation and navigation, the study of the records of weather observations are practically utilized in many of the arts and sciences, for instance in public hygiene and sanitation, in engineering works, in forestry, in some manufacturing industries, and even in warfare. The science of meteorology divides itself, therefore, into *theoretical* meteorology, in which the phenomena observed are explained and their causes deducted from natural laws of physical science, and in *practical* meteorology or the application of these laws to the science of weather prediction.

The scope of the work before us is to teach theoretical meteorology and to serve as a text-book of the elements of the science for general students. The author clearly states in the preface that his book should not be taken as a manual for practising meteorologists. For this reason, he gives only a very brief mention of the modern forms of meteorological apparatus and hardly any instructions as to how the instruments are used and how weather observations are taken. His book is rather a strictly elementary consideration of the earth's atmosphere; of thermometry and barometry or the measurement and observation of air temperature and air pressure; on winds, their causes, direction, and velocity; on hygrometry, or the measurement of vapor or moisture; on cloud formations and forms of precipitation of moisture; on atmospheric optics and electricity; on the circulation of the atmosphere, and on winds, cyclones, and tornadoes; and finally on weather, weather predictions, climate in general, and in particular that of the United States. In each of the departments the author starts out by giving the facts, and afterwards their probable explanations.

The chapter on weather and weather predictions, tho quite brief, is naturally one of the greatest interest. The author correctly defines "weather" as "the atmospheric conditions as shown by the meteorological elements at a particular time or during a short specified period," generally in one particular locality, whereas he defines "climate" as "the aggregate of weather conditions, generally applied to a larger section of country." Long continued, accurate, meteorological observations of the weather conditions serve to establish the climatic record of any section of a country.

It is of interest to note that the scientist Lavoisier predicted a century ago, the possibility of daily forecasting the weather. Weather predicting, however, was only rendered practically possible with the advent of the electric telegraph, about fifty years ago; for by means of the telegraphic reports sent daily and almost instantly from points of observation located all over a country, the forecaster is enabled to study the weather conditions existing over large areas, to determine from the distribution of the barometric maxima and minima (or the high and low centres) what the probable direction of winds and storms will be, and to apply the laws, based upon many years' scientific observations to interpret the series of observations furnished him by the telegraph service, to predict the weather for the next twenty-four hours, and to give warnings of approaching storms, gales, hurricanes, rainstorms, river floods, hot and cold waves, etc.

At the close of the nineteenth century, nearly every civilized country supports a weather bureau and a number of meteorological stations, equipped with the most perfect scientific instruments of precision like barometers, air thermometers, hygrometers or psychrometers, anemometers, rain and snow gauges or ombrometers, evaporometers, sunshine recorders, electrometers, and a number of self-recording instruments used for obtaining daily automatic and continuous records of the various meteorological observations. Meteorologalic observations are nowadays taken even on the oceans, this having first been suggested by the famous American hydrographer and geographer Maury. Many colleges have established courses of lectures on meteorology, and the science is taught at many of the universities. Those who wish to follow these studies can advantageously use as a foundation for this work the text-book of Prof. Waldo. The author has himself lectured for many years before the Signal Service Corps, U. S. A., at Fort Myers, at a time when the Weather Service was a branch of the War Department, and before it was made a part of the Department of Agriculture. The book is clearly and ably written in language not difficult to understand, and intricate mathematical calculations are wholly excluded. The text is embellished with 121 illustrations, many of these being in color, and all being rendered in a uniformly excellent style. W. P. GERHARD.

Maury's Elementary Geography.—Revised edition. Size 7½ inches x 9½ inches; pages 120; cloth bound. University Publishing Co., New York.

It is a pleasure to welcome in its new dress a book on geography which when it first made its appearance many years ago was considered a radical departure from old-time methods. Maury's plan was, briefly stated, to present in simple language, interesting facts about the people of the earth, their homes, their industries, and the regions where they lived.

In the elementary course, the author begins the study of the earth with the home of the pupil. He then presents the earth as a unit; and after the pupils have mastered and grasped these rudiments, he considers the continents more fully, and closes this first part with a general review.

Then follows the study of the countries, the political divisions of the earth. Each continent is represented by both a political and a physical or relief map.

He concludes by elaborating the topic of the earth as the home of man. The book comprises sixty-three lessons with numerous review questions. There are many illustrations, some of which are particularly good, inasmuch as they are colored reproductions of photographic views, for instance, the Cornwall coast of England, the Alps, a cattle ranch in Colorado, and a canal and palace in Venice. The physical or relief maps of the continents are treated in a novel and peculiar manner, being tinted green.

For each continent there is a full page, containing colored illustrations, giving vivid pictures of its people, of their homes, their industrial pursuits, and their mode of living. Thus, for North America, we find illustrated the Eskimos, Indians, a cowboy, a Mexican rider, a scene in Porto Rico, and city and country houses in the United States. For South America we find a picture of a farmer of Chile, an Indian of Patagonia, a cattle man of Argentine, and Indian boys. The principal nationalities of Europe are represented by pictures of Laplanders, Scandinavians, Russians, German peasants, Hollanders, Scotch Highlanders, Bretons, Spaniards, Swiss, Tyroleans, Turks, Greeks, and Italians. Asia shows the following tribes: Persians, Tartars, Koreans, Arabians, Chinese, Japanese, Hindus, Afghans, Tibetans, Siamese, Burmese, and Singhalese.

Maury's Manual of Geography.—Size 12½ inches x 9¾ inches; pages 148, cloth-bound, revised, 1900. University Publishing Co., New York.

This larger and more complete geography is intended for the use of pupils of the higher grades, who have already mastered the elementary geography of the same author. It is well adapted to the wants of the schoolroom; the new edition is well executed, and contains many new and instructive text illustrations, and many colored physical maps, also a new trade and voyage chart for the study of the principal routes of commerce. The contents embrace nine pages of mathematical and six pages of physical geography, while the bulk of the book (120 pages) is devoted to political geography. Included in the thirty maps of the book are five physical maps of the continents, on which plains are shown in green, lowlands in dark green, low plateaus in buff, high plateaus in dark buff, and mountains by means of hachure. In the political maps the entire area of the countries is colored, and not merely its boundaries. In both these respects, the maps follow the new German system. There is one general map of Europe, and one of Central Europe, and it is to be regretted that only the British Isles should have been given a special map.

Some of the most important matter of the book is contained in the map studies and questions. There is also a brief chapter on map-drawing, a pronouncing vocabulary, and some pages of statistical matter.

The publishers are keeping this edition up to date by issuing each year a supplement, containing "Recent Geographical Events" Thus, the edition before us contains Notes on the South African War (with map), Notes on the highest mountain of the United States, this being Mt. McKinley, and not either Mt. Logan or Mt. St. Elias. Mt. McKinley is located two hundred miles from the shore of Cook Inlet in Alaska, and reaches an altitude of 20,464 feet, and is therefore one thousand feet higher than Mt. Logan and nearly as high as Chimborazo.

There are also brief notes on the tides in the Bay of Fundy, and on the Samoan Islands, of which Tutuila and the other small islands came into the possession of the United States in January, 1900. There is a map of these islands as well as one of China.

Many of the features of this book are especially suited to stimulate pupils to pursue geographical studies with zeal and enthusiasm.

Maury's Physical Geography.—Size 11½ inches x 8 inches; pages 130; revised edition of 1900. Price cloth bound, $1.20. University Publishing Co., New York.

Of the three books, this last is perhaps the most valuable; it certainly is the most original and best known of Maury's works. As in the other two books, he aimed at popularizing the study of the attractive science of physical geography, by the omission of all unessential and dry details. The subject is presented in a natural and logical form; and numerous text illustrations and many instructive maps and charts add to its value. Compared with the earlier edition, the work is somewhat abridged; and the new arrangement of matter, by Dr. Mytton Maury, a relative of the author, is perhaps better adapted for use in high schools and colleges than the former edition.

The mechanical features of the book deserve much praise: the printing is large and clear, the paper of a good grade, the binding durable and tasteful. A supplement is added which contains recent facts concerning physical geography, and by means of which the book is brought up to date each year.

In addition to the chapters on Earth, Land, Water, Atmosphere, and Life, there are tables of mean temperature and rainfall, a useful pronouncing vocabulary, many interesting maps and charts, also physical maps of the continents in relief, and many smaller attractive text illustrations. W. P. GERHARD.

A very fine pamphlet is issued by the Stockton, California, schools, Superintendent J. A. Barr. It is octavo, 219 pages, of which about twenty-seven pages are devoted to geography in the grades. This outline shows a lively appreciation of the present trend of thought and instruction in geography. It will be found very helpful to all teachers who are organizing the work in the grades. The quality of the whole course of study as here outlined is to be commended.

J. P. G.

EXCHANGE MATERIAL EXAMINED AND APPROVED

[A list of the names and addresses of 105 members offering material for exchange was published in the last number of the Bulletin, and may be consulted by members desiring to make exchanges. Requests for information regarding the exchange of illustrative material should be sent to the Director of the Bureau, Winona, Minn.]

Model of Cape Cod.—Purchase price, $15.00. Prof. Vernon F. Marsters, Indiana University, Bloomington, Indiana.

The model includes Truro and Provincetown. Horizontal scale about 1.5 miles to the inch, vertical scale 600 feet to the inch. The model is of plaster, framed in oak, and is constructed by the contour method. The surface is colored, and the important features of drainage and the occupation of the land by man are indicated. Copies have been supplied to the geographical laboratories at Columbia and Cornell universities.

Forty Herbarium Specimens.—Purchase price, $2.00. Prof. J. A. Dresser, Richmond, P. Q., Canada.

Forty well mounted and labeled specimens of spring-blooming Canadian flowering plants. A properly prepared sample has been filed with the chairman of exchange committee. Minerals and plants desired in exchange.

Flax.—Purchase price, $1.00. Mr. Philip Emerson, Principal of Cobbet School, Lynn, Massachusetts.

Scutched flax (Russian, Dutch, Flemish, American), and dressed flax; and specimens showing changes from flax to linen thread and yarn. Thousand-word type-written description of process of manufacture, and bibliography of publications on flax and linen.

Copper.—Purchase price, $1.00. Miss Margaret T. Daly, Lake Linden, Mich.

Amygdaloid and conglomerate ores, native copper masses, ore containing silver, assay button, fine copper from stamp mill, miniature bar from smelting furnace, wire for different purposes, copper plate. Description of mines, mining, stamps and stamping, smelting, and rolling, in the Lake Superior district. A very desirable set of specimens.

Moose-wood.—Miss Margaret T. Daly, Lake Linden, Mich.

Section of small trunk, two inches diameter, six inches long, showing the wood and the very tough bark used by Indians for thongs, whence the popular name.

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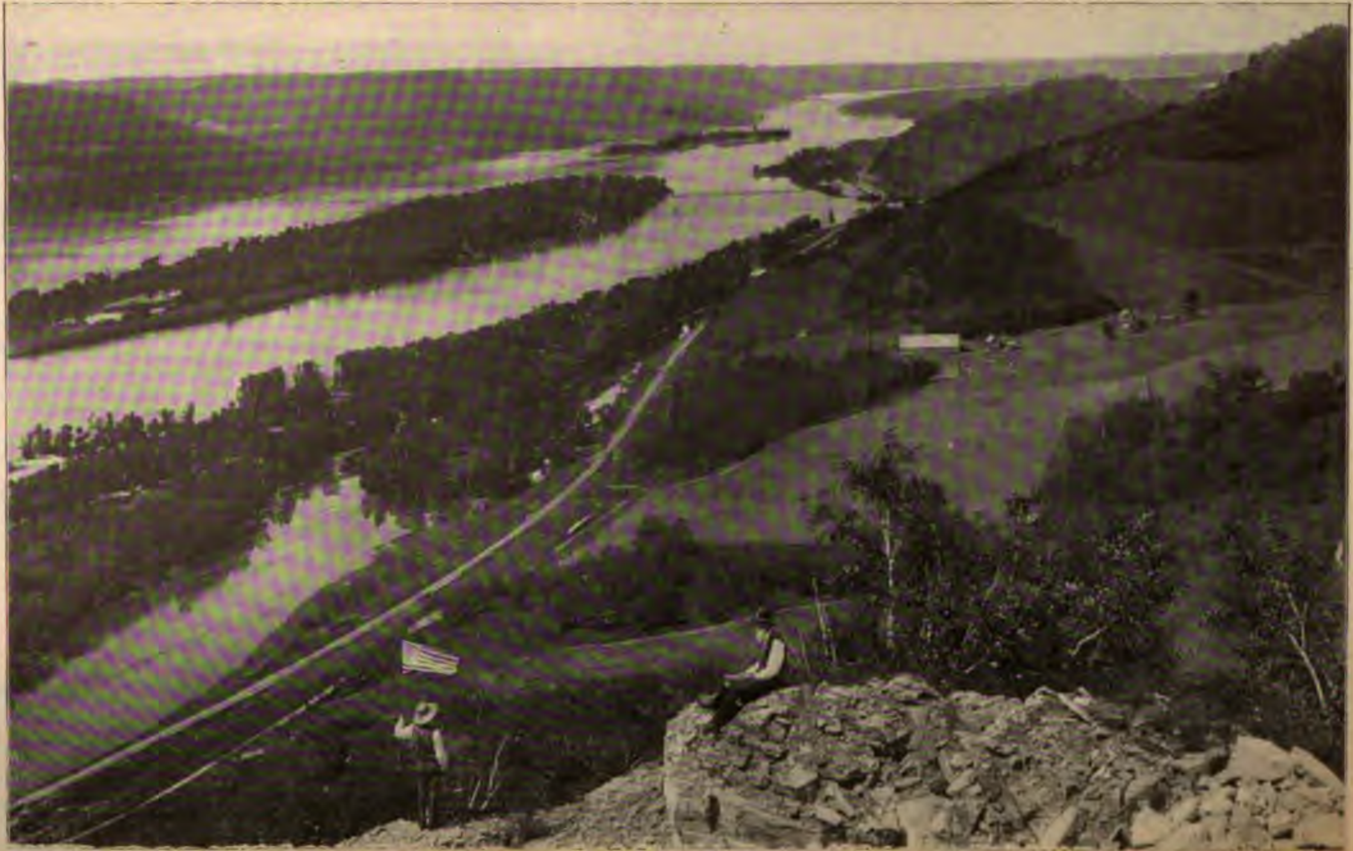

LOOKING UP THE MISSISSIPPI RIVER FROM TREMPEALEAU BLUFFS, WISCONSIN.

"The first and most notable characteristic of the driftless area is the peneplain character of the upland surface. * * * A second feature of the region is the presence of deeply incised river valleys. * * * A third feature is the mature development of the streams." Page 275.

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ON A ONE-SCALED ATLAS

BY ÉLISÉE RECLUS AND GEORGE P. RECLUS-GUYOU

By a one-scaled atlas, we mean an atlas giving a representation of the whole of the earth's surface on the same scale. It seems extraordinary that we should have come to the twentieth century and yet have to assert that schools and geographers are in urgent need of such a work. But we understand too well the reason which has till now obscured the usefulness of a one-scaled atlas. The general public knows hardly any geography except from the political point of view, and editors seldom do more than provide to the taste of the public. The natural outcome is that each sheet of an ordinary atlas must be devoted to one national political interest with complete disregard of all other factors. Physical atlases are supposed to be needed only by advanced students who should have no difficulty in translating maps of different scales into one another.

We cannot condemn too strongly such a state of things; and in the name of common sense, we ask that children, students and scientists be provided with uniform scaled atlases.

The idea has nothing new in it. Richard Proctor published one some twenty years ago, containing the world in twelve maps; but the scale was so small and the division into sheets so ungeographical that it could not be used, either by the geographer or in schools, and it did not find its way into the hands of the general public. Will no one carry on the work initiated by Proctor?

On the other hand many cartographers are aware that in regard to scales the old style of atlas must be improved; accordingly some have tried to limit the number of scales in their atlases. These improved works usually open with a few maps of the whole world showing a few special features on a very small scale and with a very great but unavoidable distortion; then maps follow in a certain geographical order, but on a scale chosen upon other considerations, tho such countries as do not differ much in size may be drawn on the same scale.

Other cartographers again give isolated comparisons. An English publisher, for example, will show on the corner of every sheet of his atlas, say India, or Great Britain, or the county of Middlesex, on the same scale as the sheet; others will give on a special page of the atlas comparative drawings of natural features, as lakes, rivers, etc. But these attempts are no solution of the difficulty. The necessity for comparison is not limited to special cases; forms, situations, surroundings, etc., are as important as the simple notion of area.

We all agree that the first pictures which meet a child's eyes remain profoundly engraved in his brain; their influence is for life and can never be completely superseded by later studies. We ought then at the very outset of education to give to the children exact pictures of the real appearance of the earth's surface, such drawings as will enable them to obtain true and lasting notions without the trouble of wading thru long pages of dry detail; while nowadays, if they understand the reality of things, it is by tedious study and in spite of the maps they find in their atlases. But that is not all, the moral point of view is of still greater importance. It is quite common to find in French school atlases that France and its colonies take up a fourth of the total number of sheets: the proportion we find in a recent good English atlas is 58 pages for the British Empire out of 120 pages contained in the atlas. How is it possible for the child who uses such an atlas not to think that his country is more important than others? How can he avoid despising his neighbors?

Of course in every school there are globes; and globes are the ideal instruments for giving vivid ideas of geography, but they are not handy in a class, especially if their dimension is sufficient to show the features of the countries. Moreover, a good globe does not make up for a bad atlas. We want a good atlas besides a good globe.

Another instrument used in schools for the teaching of geography is the wall map. We have our own ideas on the necessary improvements to be made on wall maps; but as they now stand, there would be little to say against many of them, if only the child had a one-scaled atlas in hand, which would enable him to reduce every map around him to a common standard. His atlas would then become a kind of geographical dictionary by means of which he could translate every map around him into a clear notion. Relative forms, situations, distances, would then readily appeal to the child's intellect and so obviate the necessity for laborious study.

An obvious criticism is that children must begin to study geography from their surroundings, and that they will hardly be able to recognize the features familiar to them in a one-scaled atlas of the whole world. But we do not wish that the atlas should contain maps on one scale *only*. We say, *first of all* the atlas should give a representation of the whole earth's surface on a uniform scale, but after that, other maps, or better a second volume, should give on a larger but again uniform scale—meanwhile impracticable for the whole world—regions of great importance by their population or other causes, as Western Europe, the Eastern States, India, etc.; and a third and a fourth volume on still larger but always uniform scales might obviously be added. While the first part would be a world atlas, or international atlas, which, except for the language of the letter press, might be common to all countries, the second might be slightly different in composition according to the country in which it is used; and the third and especially the fourth parts should be quite special to the schools of one district. It should not be the same for the children of Bretagne and of Provence, for those of Vermont and of Ohio, just because it would show on a large scale their surroundings. Tho here again we should like to introduce a comparative element in having in every one of these local atlases, and drawn with the same scale, the plans of the most important centres of population in the world.

But we need not insist too much on such obvious points, and henceforth we shall consider only the international one-scaled atlas.

The specialist or student who certainly knows all about scales, relative sizes, projections, distortions and so on, wants as much as does the child, a one-scaled atlas. There is no one of us above the necessity of making use of known features in order to read features of unknown countries, and of comparing distant mountain groups and ranges, rivers and lakes, capes and inlets with the more familiar examples.

One advantage of such an atlas would be that no country could be ignored, however distant and unimportant it might seem to be. It is more useful to have a reliable map of New England than of Labrador, but the two maps are equally needed for the morphological conception of nature. In studying how ice and rain, water and wind, have carved or built up the soil; how mountain and river, sea and shore constantly contend with one another, no country can be left aside as of no importance.

Nowadays, countries like the shores of Bering straits hardly come under our consideration: because few atlases show them except on the map of their respective continent—*i. e.* on a very small scale; and because, coming naturally to be placed in the corner or on the edge of such maps, they are submitted to a very great amount of distortion. No map of Asia can give an adequate idea of the region beyond the Amur. According to the projection used, the misrepresentation will affect a different character, Kamchatka may appear too large or too small, too long or too short, but no map will give its true form.

A complete series of maps on the same scale would show more exactly the state of our geographical knowledge than the atlases at present in use are capable of doing. Little known countries are generally drawn on a smaller scale than others; and, in filling the white spaces with a few names which thus receive a misleading importance, the map appears to represent a known district whereas the cartography is altogether problematical. Besides, on such small-scaled maps the surveyed parts cannot adequately be drawn, and thus, while partial ignorance is hidden, true knowledge cannot be displayed.

It can, at first, be asked with some hesitation whether the oceanic spaces ought to be represented with the same uniformity as the emerged lands. To this it may be answered that in these days when the depths of the seas, when oceanic currents, deep sea deposits, forms of plant and animal life are subjects of careful study, no spot of the earth's surface is without interest. But every doubt is set aside when we realize that no island is completely represented without the extent of sea which surrounds it. It is only the distances between the islands of an archipelago compared with their size which can bring home their true character to the student. Is not the span of sea interposed between California and Hawaii one of the principal characteristics of that island? As a matter of fact, it is impossible to find a single part of the oceanic space, the representation of which is not important in itself or in relation to some neighboring land, and therefore we must decide to leave no part unrepresented.

Coming now to an actual proposition for such an atlas a few leading conditions must be made clear, without entering into technical discussions.

I. No extent of the spheroidal earth can be drawn on a flat sheet of paper without some deformation. According to the chosen system of projection, the errors in length (distance between two points), the errors in angle (form of features), the errors in area, will have a certain value at every point of the map. There is no way of avoiding errors of some sort; but the reader of the atlas must be made aware of them and must be given the means of correcting them if he wants to make use of the atlas for any local accurate mensuration.

II. Every map should be drawn for itself with the least possible error; in other words, we cannot entertain, for example, the idea of making a one-scaled atlas by simply cutting into equalized sheets a large-scaled map of the whole world.

III. The greatest error in a map, (in length, angle, or area) depends on the extent of land represented upon it. We can therefore limit the errors to such value as we like, not forgetting, however that the smaller the area mapped out on one sheet, the greater will be the number of maps necessary for the representation of the whole world. In our proposed atlas we show Europe on one sheet, the United States on another, at the scale of 1:10,000,000; each map will be sixteen inches by twenty-four inches and thirty-six such maps are needed for the representation of the earth's surface. With the chosen system of projection the errors in the most deformed parts (near the corners) would be three per cent on lengths, five per cent on angles, and none on area.

IV. Every map of the atlas must show something interesting in itself, and as far as possible a complete geographical unit, such as countries or seas which belong to one another by morphology or by climate or by historical development. To give an example: part of the Antilles will be shown on the map of the States, but nevertheless must another map of the one-scaled atlas represent the whole of the Antilles and of the Gulf of Mexico from Texas to Guiana. Maps of the atlas will therefore overlap, especially those dealing with the continental masses.

We would advise three editions of the atlas which we have studied: a Physical atlas, a School atlas, and a Pocket atlas.

Physical one-scaled atlas: Scale 1:10,000,000, 36 maps, 16x24 inches.

School one-scaled atlas: Scale 1:20,000,000, 36 maps in an atlas, 8x10 inches.

Pocket one-scaled atlas: Scale 1:50,000,000, 36 maps in an atlas 4x5 inches.

GEOGRAPHIC ENVIRONMENT

BY J. F. CHAMBERLAIN

In the long vanished past, that dim, uncertain time called by Clodd the childhood of the world, man walked with slow and faltering step, guided and controlled by the hand of Nature. He lived, as did the lower animals, in direct contact with her, his welfare depending upon his ability to use the blessings which she offered, or to overcome the obstacles which she placed in his path.

Slowly, yet surely, this child of nature grew in mental and moral strength until to-day he has harnessed and put to work forces which he once feared and offered sacrifices to, while other forces in the past unknown and undreamed of, are now his willing servants.

Thus, altho the relations between man and nature have changed materially with the development of the former, the subject of "geographic environment" is to-day, and must ever be, one of great importance to the student of geography and human affairs; and no study of place or people can be complete if it leaves this out.

The realization that the social condition of man is to a considerable extent the result of his physical surroundings, dawned slowly; but at the present time the tracing of the relation between the geographic and the social environments is the central thought in geography.

Ritter, who did so much to bring about a rational treatment of the subject, says: "Is it not worth while, for the sake of the history of men and of nations, to study the earth in its relations to its inhabitants?"

Buckle has shown that nature acts upon man chiefly in two ways. Food, soil and climate have a marked influence upon his social condition. They have to do with the accumulation and the distribution of wealth, and therefore with the distribution of power or government. The general appearance of nature—her mountains, forests, streams, etc.,—has to do with the thought of man. His religion, literature and art are determined in part by this.

It is believed by many that the division of mankind into races is the result of these varying physical conditions. For example, the environment of the Negro could not have resulted in any other human product.

In his "Principles of Economy," Mill says: "Of all vulgar modes of escaping from the consideration of the effect of social and moral influences upon the human mind, the most vulgar is that of attributing the diversities of conduct and character to inherent natural differences."

Where the soil makes but scanty returns for man's labor, we find the people daily consuming all or nearly all that they produce. The same is true of a roving people. There is then no accumulation of material things. There must be constant labor to provide for daily necessities. Without leisure there is no opportunity for social development.

Where soil is fertile and climate favorable, food is produced easily and in abundance. This means the origin of a wealthy or non-productive class. It is to this class that we must look for progress.

All the ancient civilizations of the world without exception were located where the minimum amount of labor would produce the maximum amount of food. In proof of this witness China, India, the valley of the Tigris and Euphrates, and Egypt.

One of the best proofs that differences in the social organization of peoples are not due to any peculiar qualities existing in the peoples themselves, is found in the fact that a race may in its own home exhibit very little progress and yet when surrounded by new physical conditions it may advance materially.

The Arabs furnish us with a good example of this. In Arabia they were in the past, as they are to-day, hardly more than wanderers, but in Spain and western India they exhibited considerable culture. They erected magnificent buildings and established great libraries. The Tartars on the Steppes of Siberia were a fierce uncivilized people; in China they developed quite a high civilization. The American Indian is the same from Alaska to Patagonia, yet his social condition varies so greatly as to make it appear as tho there were several races. In Peru, in Mexico, and even in certain parts of the "arid west" where, owing to irrigation, food was easily procured, we find that the Indian made considerable progress.

Where food is easily obtained and its sustaining power great, we find dense populations, low wages and poverty on the part of the productive class, and great wealth and power on the part of the leisure class.

It is said that an acre of potatoes will sustain twice as many persons as an acre of wheat. In Ireland, before the days when emigration became important, the population increased at the rate of three per cent per year, while in England it increased hardly one and one-half per cent. Where rice is the staple article of food, we find the birth rate high, and the population dense.

Just as the social condition of man depends largely upon the ease with which food can be obtained, so his literature, his religion and his habits of thought generally, depend in no small measure upon the phenomena of nature.

The almost impassible snow-crowned Himalayas, the mighty streams, the intense heat of the plains, the destructive typhoons, the dense, impenetrable forests, all combined to overpower the native of India and to make him feel almost helpless in the presence of nature. Seeing that the forces of the physical world worked sometimes to his advantage and sometimes to his disadvantage, it was perfectly natural that he should invest these forces with spirits, and then worship them and sacrifice to them in order to gain their favor. The Indian worshipped these nature gods not for spiritual uplift but in the hope of material gain.

In India, as in other eastern countries where similar conditions prevail, there was an impassable gulf between mankind and the gods. The representations of the latter were horrible and the religious ceremonies were often inhuman.

In Greece, on the other hand, nature had an elevating and stimulating instead of a depressing effect. The gods and men had much in common, while the most beautiful statues represented the former.

The most densely populated portion of India is the basin of the Ganges. This is because the Ganges and its tributaries have for untold ages been bringing vast quantities of rock waste from the mountains and spreading it out in the form of a great delta and alluvial plain. In some parts of the fertile region as many as nine hundred persons on every square mile depend upon the soil for a living. This, of course, results in cheap labor, in poverty, in ignorance, and when crops fail, in famine and pestilence. These very conditions keep adding to the wealth and the power of the non-productive class, however.

Egypt, the "gift of the Nile," was one of the "nest places" of history. Here literature, science and art were developed to a considerable degree, at a time when less favored peoples were living in barbarism.

Shut in by mountains and almost trackless deserts it was thus rendered comparatively free from invasions. The Nile, rising in regions of periodic and abundant rainfall, brought both water and fertility to the lower part of the valley. As the river has no tributaries for hundreds of miles from its mouth, the tillable portion of the valley is very narrow, averaging less than seven miles. The regularity with which the inundations occurred and their absolute necessity suggested the presence of a controlling spirit and the desirability of worshipping that spirit. We get a glimpse of the worship of the physical world in the following extract from a hymn to the Nile.

"Shine forth, shine forth, O, Nile! shine forth!
Giving life to man by his oxen!
Giving life to his oxen by the pastures!
Shine forth in glory, O Nile!"

The planting of the crops was regulated by the annual overflow of the stream, and therefore it was eagerly awaited. The seed was thrown on the mud as the waters receded after the flood and was then trampled in by cattle, or a tree with limbs was dragged over the ground.

The study of astronomy which began here at a very early time was no doubt promoted by observing that the floods occurred each year when the sun was in about the same position.

In the paintings of the Egyptians, yellow is very common and it has been said that this is due to the yellow or brassy cast of the desert.

Geographic control is emphasized on the Sahara and Arabian deserts. It is only where isolated mountain masses rise to a considerable height that rain falls. Here we find springs, grass, and date palms. Travel, difficult and dangerous on such wastes, naturally follows the line of these oases. Because of the scarcity of both food and water, camels are very commonly used, and it is said that a camel, because of its peculiar value, is sometimes more highly prized than a child.

As it is often necessary to move from place to place in search of food and water, these people have very little of the home feeling. This shifting from one section of the country to another seems to have destroyed to a considerable extent the recognition of personal ownership, and therefore theft is common.

The conditions under which they live make them very hospitable, especially to people of their own class, but they are naturally very liberty loving and spirited.

On account of the scarcity of water, the Bedouin is very careful as to its use, and to apply it externally is regarded as almost criminal. As a partial compensation for the lack of water-baths, sand-baths are resorted to.

Wood being scarce and metal heavy to transport, most of the few household utensils are made of gourds and calabashes.

It is said that the sight of these children of the desert is developed to a wonderful degree. This results from necessity. The winds are constantly drifting the sands, changing landmarks and filling the tracks of the animals. Only the closest observation, the noting of every detail, will enable one to keep the way.

The office of professional guide is generally hereditary and these men are very proud of their powers and are highly respected by their fellow-men.

Although living under conditions very different from those just described, the Eskimo is none the less strongly influenced by his geographic environment. Vegetation being very scanty, and consisting of low forms only, his home must be constructed of skins, ice and snow.

Agriculture, the basal industry of mankind, is impossible and hence animals must furnish the food supply. This is true of fuel and clothing also. To capture the animals which must furnish himself and family with the necessities of life requires much skill, patience and courage.

The only means of transportation are by boat and sledge. These are almost entirely made from the skins and bones of animals.

Owing to privations the Eskimo, like the Bedouin, is generally somewhat dwarfed. Like his desert brother he also is quite uncleanly on account of the lack of water.

Diversity in the physical conditions of an area results in diversity in its life.

The Eskimo lives under almost uniform conditions as to climate, scenery, food, occupation. As a result he is stolid and unimaginative and without a history.

Great Britain, one of the most important industrial, commercial, intellectual and moral forces in the world to-day, owes her importance in a high degree to her geographic environment.

The influence of the "silver streak," across which the great Cæsar gazed at the chalk cliffs of Dover some forty miles away, has always been great. Narrow as it is, it formed quite an effective barrier to continuous communication between the island and the main land. Thus, altho invasions occurred, they could not be as effective as they would have been had England been a part of the continent. The Romans could not Romanize England as they did other parts of their empire. A storm occurring unexpectedly on the channel is said to have prevented Napoleon from invading England. That England has not been obliged to maintain a great standing army but has developed the most powerful navy in the world, is due to this same separating channel.

Shakespeare says,

> "This fortress built by Nature for herself
> Against infection and the hand of war;
> This happy breed of men, this little world,
> This precious stone set in the silver sea,
> Which serves it in the office of a wall,
> Or as a moat defensive to a house,
> Against the envy of less happier lands;
> This blessed plot, this earth, this realm, this England."

The ancient Celtic language is now almost obsolete. In Wales, in Ireland, and in the highland section of Scotland, it is still spoken The inaccessibility of these areas kept back the influence of conquering civilizations, and so the customs and forms of speech have remained practically unchanged.

Scotland would never have added to the world's history so many pages of heroic deeds had it not been for the physical conditions of the country.

The influence of the "Lake Country" upon the writings of Wordsworth, Coleridge and Southey is undoubted.

England has untold wealth in the form of deposits of coal and iron without which she could never have assumed importance industrially. These deposits are close together—a point of great economic value. They are also near the coast. Thus the cost of transportation is reduced to the minimum.

As extensive manufacturing calls for vast quantities of raw material and as this material cannot be produced in England, she naturally sent her ships to all parts of the earth in search of it. This led to the growth of her merchant marine and to commerce.

Furthermore these conditions paved the way to the acquisition of territory and the development of a great world power.

Manufacturing means a dense population; and consequently we find in a country much smaller than the state of California, 40,000,000 of people. This means competition, low wages, cheap living, and fewer home comforts than there would otherwise be.

One of the most important factors to be considered in explaining the greatness of Great Britain is the Gulf Stream. This magnificent ocean river bathes its shores in a flood which is at a temperature ten or fifteen degrees higher than that of the waters of the ocean in that latitude. The anti-trade winds drifting over this stream convey to the land its high temperature. Thus in the same latitude with Labrador which is practically without inhabitants or even great natural resources, we find the populous British Isles. Had the Isthmus of Panama and Central America failed to lift themselves above the waters of the sea, we would not be studying English history in our schools to-day, and English influence would not be manifest in your life and in mine for there would be no England.

When the French settled in Canada they found the Saint Lawrence valley to be the natural avenue leading to and from the interior. They established a town at the head of navigation to serve as a point of reshipment and a base of supplies. For a long time Quebec was the most important point on the river. Within recent years the channel of the Saint Lawrence was deepened as far up as Montreal and vessels drawing twenty-two feet of water can now reach that city. From that time Montreal increased rapidly in importance while Quebec declined, and to-day the former is the commercial center of the Dominion of Canada.

One of the bloodiest and most devastating wars known to history may be traced indirectly to geographic control.

Both the soil and the climate of the Southern States favor the easy accumulation of the necessities of life. At the same time the climate tends to enervate the white man while it is well suited to the negro.

It was found that slaves brought to this country could work to advantage in the South but not in the North. Furthermore, they could do better at agricultural labor such as picking cotton and cutting cane than they could in the mills and factories of the North.

It was for this reason and not on account of any moral inferiority that slavery arose in the Southern States but not in those of the North.

In the New England states the people settled in communities and villages, while in the South they were widely separated owing to the large plantations. This led to the development of that great hospitality for which the Southerner has always been noted.

Having many human beings under his control, freed him to a certain extent from personal labor; and the fact of lordship and of leisure naturally led to aristocracy and pride.

That Michigan is one of the most important peach raising states of the Union is a well known fact. Boat loads and train loads of this fruit are shipped every summer from the southern peninsula to Chicago, and many other cities and towns.

Why should not southern Wisconsin and northern Illinois produce their own peaches? Neither latitude nor altitude vary materially.

The winter isotherms show a marked deflection to the northward in southern Michigan, thus proving that the temperature is higher here than it is west of the lake. The anti-trade winds which are the prevailing ones for this part of the world, blow over the land for a long distance before reaching Wisconsin and Illinois. Hence they bring to these areas land conditions. The same wind when it reaches Michigan has blown over Lake Michigan thus bringing water temperatures to the peninsula. The temperature being higher in the winter east of Lake Michigan, than it is west of it, the fruit trees do not generally winter-kill.

California shows in a striking manner the influence of geographic environment upon its products and the life of its inhabitants.

When the discovery of gold in 1848 became known, there was a perfect tidal wave of humanity directed toward this coast.

In most cases the movement was a hurried one. Men came expecting to amass a fortune and then go back to their homes and enjoy it. Because of this, comparatively few women came with the early seekers after wealth. Thus there was lacking the home spirit, permanence, and, to a certain extent, law.

Later, when it was found that the valleys of this great state were fertile and would yield all sorts of vegetable products, people came to develop the country and to make homes for themselves.

The climate of California is much milder than that of other sections in the same latitude but east of the Sierra Nevada mountains. As a result of this, fruits, such as the orange, lemon, fig, olive, etc., are produced. In the northern part of the state the rainfall is considerable on the western slopes of the mountains and as a natural consequence great forests clothe them and lumbering is an important industry.

The great mountain wall on the east completely shuts off California from the rest of the United States. This makes railroad construction expensive and, therefore, freight rates are very high. None of the immense amount of wheat raised in the state is shipped by rail as it will not bear the cost of transportation.

The social conditions in southern California are particularly favorable. The people are of a high grade of intelligence. More good homes are found than in most sections. The number of books and periodicals read is greater per capita than in any other part of the United States. Visitors are struck by the culture and refinement of men who are performing very menial labor.

One phase of the geographic environment of the country is largely responsible for this—namely climate.

Southern California is the climatic Mecca of the United States. Hence great numbers journey to it for the purpose of more fully enjoying and prolonging life. As traveling is expensive and as living without a regular income is still more so, it follows that the majority of those who go to take up their residence there are in moderate or good circumstances. As wealth means a certain amount of leisure and as leisure means increased opportunities for the acquisition of knowledge, it is but natural that the population should be above the average in intelligence and morals.

It is not the purpose of this paper to multiply illustrations of the well known fact that nature and man are closely related, nor to attempt to point out all of these relations. Its object is to show that racial characteristics may be explained on the basis of geographic control; that food, soil, climate and the phenomena of nature exercised a strong influence upon the civilizations of the past as they do upon those of the present day; and that altho man's dominion over nature is constantly increasing, he must ever be to some considerable extent under her control.

RUSSIA AND SIBERIA

BY MARY A. FLEMING

In the articles lately written about Russia, the authors have generally told the truth or their impressions as such. Still, since my return from the land of the great white Tzar, I have read some late books on Russia, which I should think had been written by persons who had never been in the country. The Russians are aware of these misrepresentations and are anxious to have enlightened and intelligent visitors see and learn as much as possible of their country and its government, so that, when they return to their own countries, these travelers will be able to tell the truth to their compatriots.

Including Siberia, Russia has an area of nearly nine million square miles, the greater part of which is uninhabited, altho the present population is 130 millions or more.

The immense size, the soil, and the geographic structure of Russia, make a great difference between it and the rest of Europe. The great steppes or plain, the largest on our planet, stretches out flat and monotonous, till, passing below the Ural mountains, it reaches far into Central Asia. This great plain is very like our own prairies of the west, in the preservation of the marine character of its surface and in its typical fossils.

The highest table-land in European Russia, is the Valdai mountains, which is not quite 1100 feet in elevation above sea-level and is northeast of Moscow. This region abounds in springs and small lakes, and here are the sources of all the great rivers of Russia, which finally reach the four great seas which border on the largest country in Europe. The Volga, the largest river in Europe, is 2,400 miles long. The upper part of the river has cut its way thru hills, and its left banks down to Kazan are as high as those of the Rhine. Here the scenery is picturesque; but as one sails south in the steamer (whose fires are fed with petroleum) it becomes less interesting as it flows thru flat, marshy, salt deserts into the Caspian sea. The Don flows into the Sea of Azof, the Dnieper into the Black sea, and the Dwina, the only large river flowing north, empties into the White sea. The great Siberian rivers are the Obi (Ob), Yenisei, and Lena, which flow north into the Arctic ocean, and the Amoor which flows into the Pacific ocean. The Russians have found, during recent surveys, an open sea and sheltered harbor at the mouth of the Obi, and that the Yenisei has no bar and is navigable for ocean steamers for one thousand miles from its mouth. Two years ago, the government built on the Murman coast, the Arctic harbor of Alexandrowsk which is north of the Arctic circle, but is free from ice, as a branch of the Gulf Stream reaches it. This harbor is deep enough for the largest ships, the small town is lit by electricity, and is an outlet of trade for the northern part of Russia.

The Caucasus mountains form a gigantic bulwark between the Caspian and the Black seas. The foot of the chain lies below the level of the sea, and its summit is over three thousand feet higher than that of Mont Blanc. Mt. Elbruz reaches the greatest altitude, and there are several others in the chain whose glacier-covered peaks outrank the giant of the Alps.

The great breadth of the steppes, condemns Russia to great extremes of heat and cold. The fierce, hot winds of summer, and the bitter, cold blasts of winter, sweep across the steppes and cause the people to build their houses close to the sheltering banks of the rivers.

The Caspian sea, 85 feet below sea-level, and the Sea of Aral, are the remains of that great body of salt water, which, in comparatively recent times, covered the land from the Baltic sea to the Black sea and from the Arctic ocean to the Caspian sea and the Sea of Aral. The northern part of the Caspian sea and the Sea of Aral freeze in winter, and so does the White sea. The Black sea remains open, tho often the rigging and hulls of ships are covered with ice, as are sometimes covered our own lake steamers. In February of last year the heavy coating of ice on a steamer caused it to sink near Odessa.

We must remember that nearly all of Russia is farther north than New York city. The southern coast of the Crimea is but the prolongation of the Caucasus mountains. The Crimea is the winter resort of the rich, whose beautiful homes are among the fertile hills. The climate of southern Russia resembles that of New England, New York and Pennsylvania; and in the northern part, the climate is very much like that of our own northern states, and of the inhabited parts of British America and Alaska. The climate of Siberia is almost identical with that of Russia, except that the central part is subject to greater extremes of heat and cold.

Finland is a rocky land called Fennland on account of the marshes and small lakes resting in bowls of granite, which abound in the eastern part. Of the many hills, only a few are more than five hundred feet in elevation above sea-level.

The Russians have for the last thirty years, made a scientific study of the soils of their country and have established numerous agricultural stations. several of which are in Siberia. They divide the country into five zones:

1. The glacial, is the land of the "tundras" or polar marshes and barren spaces. This is a dreary tract of land, extending across the Ural mountains into Siberia. On these wastes, whose sub-soil is constantly frozen, only mosses, lichens, and a few stunted bushes, and dwarf birches can grow, and in them were found the frozen remains of the mammoth, bison, and ox, now seen in the Russian museums. The few inhabitants, nomads, live by hunting and fishing.

2. South of 65° north latitude is the forest zone, extending from the "tundras" to the center of Russia, from Kiev to Kazan. This broad belt of tall forest trees, called "taiga" or "urman" is partly of primeval pine, spruce, and fir trees and partly of birch; farther southward grow the linden, the maple, the elm and the oak.

3, 4, and 5, are the woodless zones. Three, is the "tchernoziom" or black mould zone, which extends toward the Caucasus. This is one of the richest and most fertile tracts in the world. The name is from the bed of black humus, which is often five feet in depth. It is the granary of Russia and a rival to our own western prairies. Two-thirds of the inhabitants of the country live in this zone.

4 is the zone of the fertile steppes, and in time will form

part of the black mould zone. The tall grass and the umbelliferous plants are often more than six feet in height.

5 is the zone of the sandy desert steppes extending to the Crimea and to the Caspian sea, and stretches out into the Kirghiz desert. The Crimean peninsula is very fertile, and grapes are raised in great quantities. Trans-Caucassia is a wonderfully prolific region in which all known fruits and vegetables grow easily in the fertile soil.

The rich Armenian table-land extends south to the snow-crowned Mount Ararat, at the junction of Russia, Turkey and Persia.

The word "*oural*" means stone belt and the low Ural mountains are also called the backbone or spine of the empire. The highest of these peaks does not reach the limit of eternal snows so there are no glaciers on them. The snow lies on the plains on both sides, sometimes for seven months in the year. During the short hot summer the vegetation ripens quickly. There is no difference between the forests on the two sides of the Ural mountains and not until one reaches Lake Baikal is seen a difference in flora and fauna.

Siberia was conquered in the latter part of the sixteenth century, and its great wealth in minerals was then discovered in the metamorphic rocks of the Ural mountains.

The northern part of Russia is underlined with rich beds of copper and lead. Erratic blocks of Finnic granite are scattered down to the fertile plains south of Moscow in the basin of the Don; on both sides of the Caucasus and in Siberia are immense beds of coal. Coal and iron deemed the two great necessities of modern labor are very abundant. Some of the great iron factories in Siberia have been in operation for over 150 years. Many mines of gold, silver, mercury, and of the essentially Russian metal platinum, are worked; and many more lie yet untouched. All the precious and semi-precious gems, and valuable earths and buildingstones abound.

Siberia occupies the whole of the northern part of Asia and lies between 45° and 77° north latitude and between 60° and 190° east longitude (from Greenwich). It covers one-fourth of Asia, about one-ninth of the land surface of the earth, is two and one-half times larger than Russia in Europe, and nearly one and one-half times as large as the whole of Europe.

Geographically the Russians divide Siberia into three regions, viz., Western Siberia, Central Siberia and Eastern Siberia. Western Siberia has been colonized for centuries by emigrants from Russia, who were attracted by a climate like their own and by the rich mining districts of the Ural and the Altai mountains. Central Siberia with its tablelands has a colder climate than Western Siberia. Separating it from Eastern Siberia is Lake Baikal, which is the largest fresh water lake on the eastern continent, and has an area of 13,000 square miles. In 1900 the chart of this lake was corrected and four light houses built on the most important points of its coast, making it safer for steamboats.

The Yakutsk territory includes the basin of the Lena river, and is rich in coal, iron, salt, silver, precious stones, and above all, *gold*, which induces emigration in spite of a climate so severe that only in the south can any agriculture flourish. Eastern Siberia includes the Amoor region, which was ceded to Russia by China in 1860, and the island of Saghalien obtained from Japan in 1875, and which since then has been a place of confinement for criminals of the worst class. The southern portion of Eastern Siberia up to 55° north latitude is well cultivated in the numerous fertile valleys of the Trans-Baikal basin and the flocks and herds of the nomadic tribes find excellent pasture on the steppes.

The Trans-Siberian railway passes thru the most fertile part of Siberia.

The Russian government has tried many ways of colonizing Siberia: by exiled criminals, by prisoners of war, and by encouraging voluntary emigration. The number of convicts is not great in comparison with the voluntary settlers. Now that the railroad has brought the east and the west together, the Russian government, according to a reliable official report, has decided to discontinue the transportation of convicts to Siberia.

At the beginning of the nineteenth century, there were in Siberia six hundred thousand Russians, the majority of whom were free settlers. After the emancipation of the serfs in 1861, by the emperor, Alexander II, emigration increased until up to 1892, when for the last ten years the number reached about forty thousand annually. The government gives land and all sorts of aid to colonists, as it is anxious to have the country settled by its own people. At present about eighty-five per cent. of the population of Siberia are Russians; the other fifteen per cent. are mostly Kirghiz and Mongols.

The three main race elements of Russia are the Finns, or

Tchuds, the Tartars, and the Slav which has nearly absorbed the other two. The Cossacks (Kusak), are not merely hardy soldiers, but the inhabitants of southern Russia. They are, the Cossacks of the Dnieper, the Cossacks of the Don, and the Cossacks of the Volga. Some of the latter have settled in Caucasia and are called sometimes Cossacks of the Tereck. There are the wild nomadic Kirghiz and Kalmuk tribes and many other races which will be assimilated. All languages, like all religions are tolerated, but the Russian language *must* be taught in all schools, and *must* be used by all railroad and other government employees.

The Tzar is an absolute autocrat, but he is assisted in governing this immense empire, by the council of state, the senate and the Holy Synod. The ministers who form the council of state are ten in number and each is only responsible to the Tzar. They are the ministers of the court, of foreign affairs, of war, of the navy, of the interior, of public instruction, of finance, of domains of the state, of ways of communication (bridges and roads), and of justice. There are governors and vice-governors of each large city and of the ninety-nine governments into which the country is divided. Of these fifty are in Russia, ten in Poland, eight in Finland, twelve in the Caucasus, eight in Siberia, and eleven in Central Asia. There are many minor officers in the subdivisions of these districts.

The village commune or "Mir" is, in fact, a pure democracy—a co-operative association of the local peasants of each village, under a president elected by themselves, who exercises paternal authority in conjunction with the village parliament, which is convened in cases of emergency. Five-sixths of the people live in these communes.

There are ten great universities in Russia; St. Petersburg, which is a very beautiful modern city, has the largest of these universities, has schools of mines, of technology, of forestry, of medicine, of law, for civil engineers, for the blind, and for the deaf and dumb. There are 21 gymnasiums or high schools for boys, 22 for girls, and 450 elementary schools. Moscow is pre-eminently the most wonderfully charming city of the world, with its old Kremlin (Kreml) whose spires of gold glitter in the sun, and whose great palaces contain the richest and most beautiful museums in the world. It is a city of 450 churches, but it also has 450 elementary schools, besides many higher institutions of learning.

Warsaw (Varsouvie) is the next city, and was formerly the capital of Poland. It is to-day scarcely Russianized, has four times as many Roman Catholic churches as it has of Greek Catholic, and is a garrison town.

Odessa is a very modern shipping port on the Black Sea, showing here and there its ancient Greek origin. All around the Black Sea, and over into Asia, are the remains of ancient Greek or Scythian cities, and one passes over the classic ground of ancient Greek history by the road on which the Argonauts passed over in search of the golden fleece.

Lodz and Riga are modern, but Kiev on the Dnieper is not. It retains much of its old time simplicity and the remains of its ancient Kremlin. (All old cities in Russia had a Kreml, which was a walled enclosure, usually on a hill.) It is the center of worship. It is the holy city of Russia, of the Greek church of which the Tzar is the head.

Kazan on the Volga is a thriving city, partly modern; one-half of it is a Tartar town, with a mosque and Tartar shops. The Tartars have the monopoly of certain goods, such as the manufacture of morocco, leather goods, etc.

Nijni Novgorod, famous for its annual fairs, is losing much of its oriental character since the advent of railroads. The glitter of the electric lights along the shores of the Volga river, and on the long bridge connecting the city proper with the part occupied by the fair for only three months in the year, shows a modern spirit; but also shows that the fair will soon be, with its great modern bazaars, only a huge national exposition.

Tiflis, the ancient capital of Georgia, is now much more oriental, with its small beautiful Turkish, Persian and Armenian shops. It is very picturesque, partly built on the side of a mountain, and the Kur river cuts it into sections.

Baku, on the Caspian, is a fine large city, the center of the great petroleum trade. Natural gas, too, abounds there.

Ekaterinburg, in Western Siberia, has grown from a small fort to a large manufacturing city, in which one prominent industry is the cutting and polishing, in the imperial and other factories, of the precious and semi-precious gems. The inhabitants, like others in cities east of the Ural mountains, say, we are geographically in Siberia, but politically in Russia. And the day is not far distant when all the great empire will be Russia.

Many of the Siberian cities have more than 20,000 inhabitants. Some of the mining towns resemble those in our own mining districts. The Russian peasant villages are all alike, in one long street. The small houses (isba) have generally only one story, the overhanging roof and window blinds rudely decorated with perforated wood work. High wooden fences between the houses enclose the sheds for the carts, the utensils, and the stables for the horse and cow. In each house, there are two rooms with a corridor between them, and in the back or black room is a great brick stove, upon which the whole family sleep in the long cold winter. The furniture is of a most primitive type of wooden tables, benches and utensils, but in one corner are hung the "icons," or images of the saints, before which hangs a lamp. The dress of the peasants (monjiks) is a cotton shirt, a long coat bound at the waist, a fur cap in winter and in summer a high straw hat dating from the time of Peter the Great. They wear either sandals made of birch bark or high boots, and in winter fur boots and a long circular lined with sheepskin. The women wear a chemise of coarse cotton, a dress of bright colored calico, and cover their heads with a cotton handkerchief of another color, except on fete-days when they wear a species of diadem, now rarely seen, and in winter a thick cloak tightened at the waist.

The Trans-Siberian railway will soon be completed. The route across Russia and Siberia will be 6,400 miles long. On the 19th of May, 1891, the present emperor Nicholas II, then heir-apparent laid the first stone at Vladivostok. On the Pacific ocean many side-lines and branches will later on be built. At present, ice-breaking boats ferry the cars across stormy Lake Baikal. When the line is built around the southern end of the lake, the journey will be much shortened. The section of country now reached by steamboats on the Shilka, Sungari, and Amoor rivers, will in the near future be connected by railroad lines.

Many of the villages and military posts planted along the Amoor river in 1858, are already growing into cities of more than 15,000 inhabitants. Blagovestchensk has 38,000 and many handsome residences; and Kirin, a garrison town on the Amoor has 200,000 inhabitants. There has never before been anything in the world to compare with the present rapid settlement of Siberia, except the settling a few years ago of the western part of the United States.

THE MANUFACTURE OF LINEN YARNS AND TWINES

BY PHILIP EMERSON

In previous papers,[1] the geographical distribution of flax culture, and the preparation of flax for market, have been discussed. This paper briefly considers leading phases of linen manufacture, excluding the processes of weaving and finishing cloth. It is designed to accompany the set of flax specimens[2] which is offered in exchange, and may serve as a suggestion to others preparing descriptions to accompany exchange sets.

After the flax stalks have been retted and scutched to separate the valuable fiber from the waste, woody matter, the following processes simply serve to finely divide the fiber and to spin it into yarn which may be woven into linen cloth or twisted into linen twine. While fiber of cotton, silk, or wool, is of definite size, the bast fibers of a plant, as flax, may be divided into strands of almost any desired size. One of the most valuable qualities of flax is this which enables it to be split again and again until the finest strands of fiber are secured. Thus if somewhat harsh and brittle, flax is used for the coarsest bundle twine and crash cloth, while from soft and pliable stalks the finest thread and the most delicate linen fabrics are made.

The flax fiber is divided by combing it upon an array of long, stout, sharp, vertical, steel pins, set closely in successive lines. The instrument is a hackle, and the process hackling. Formerly all hackling was by hand, the hackle being stationary while the flax was held in the hand and drawn across and thru the teeth until fine and clean. Now much flax is hackled by machinery. Most flax imported to American mills has been already hackled, or dressed; but the Smith & Dove Mfg. Co., of Andover, Mass., import their flax undressed or simply scutched. On a hackling machine, suitable portions of flax, or pieces, are held in steel clamps, while short pins set in the slats of traveling aprons on either side pass thru the flax and comb or hackle it. At one end of the machine the pins are coarse and far apart, at the other fine and close set. The clamps that hold the flax are on a track that moves automatically, first lowering the flax between the descending pins of the hackle for a brief period, then raising it and moving it on to the next set of pins, between which it is in turn lowered for further combing. At the end of the first machine of each set of two, boys remove the pieces of flax from the clamps and reclamp them so as to leave the end not yet hackled ready for hackling as it travels back on the second machine. As the flax is hackled, all the short fibers, or tow, cling to the pins until brushed off by rolls which clean the pins as the apron turns back over the lower roll or pulley. The dust and dirt drops at the center, and is gathered up and burned. Thus the tow is clean, and is saved for use.

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[1] Bulletin of the American Bureau of Geography, Vol. II, No. 2.

[2] See list of approved material published in this Bulletin.

Some flax is still hackled by hand, since this allows the exercise of judgment in deciding how much hackling any piece of flax, or any part of a piece should be given. The machine necessarily treats all alike. Hand hackling avoids over-hackling and the waste of good fiber thru tearing it up into less valuable tow.

After the flax is hackled on the machines, it is sorted by hand hacklers, if it is to be used in fine threads. These skilled men pass the flax first thru a coarse, then a fine hackle, and comb out all the nubs or small snarls left by the hackling machines, and which would spoil the evenness of fine thread. Then each piece is laid on one or the other of two piles according to the fineness of the fiber as determined by the feeling. Many details of the work are related by a skilful hackler. For instance, the flax is worked longer toward the crop end, or seed end, for thus one works with the fiber to its smaller end, and there is less waste than when working toward the root end. The flax varies from year to year, and must be studied by the hackler to ascertain the best way of handling it. In Europe the main object is to secure fine fibers for linen cloth; in America the hackler works to secure the strongest fiber, since it is mainly used for thread.

After hackling has split the flax into fibers of the desired size and measurably cleaned them, the fibers must be drawn out and laid side by side in a long, loose ribbon or sliver, ready to be spun into yarn. The ordinary combing or carding machines, which lay the short fibers of cotton, wool, or tow parallel, would but serve to tangle the very long flax fibers. So special drawing machinery is needed.

The first machine is a spreader, so called because the flax is spread in overlapping pieces in four or six rows on the inclined surface of a broad moving belt, which carries it forward to where it passes between two rolls. Beyond the first pair of rolls is a second pair, the distance between the two being somewhat greater than the longest flax fibers. This is because the second pair of rolls turns more rapidly than the first, and the fibers in its grasp are drawn gradually away from those in the grasp of the first set. As the flax leaves the first rolls, successive sets of pins resembling those of the hackles, but closer and finer, and borne on separate steel rods, are pushed up among the flax fibers, and move slowly along toward the second pair of rolls, near which they drop down and travel back below. At first the fibers cross from side to side in the rows of flax, but as they are drawn thru the sets of pins, or gills, the tendency is to draw each fiber either entirely to the side or to the center of the sliver. At the end of the machine the six thin slivers are combined into one, which passes into tall cylindrical holders.

Often two grades of flax, as Dutch and Courtrai are placed on the spreader at once, so that the final sliver mingles the two to obtain just the quality and value of thread wanted. The several purposes of thoroly mingling different grades of flax, drawing out the fibers until parallel, and forming a sliver of uniform weight thruout, are but partially accomplished on the spreader, and the flax passes thru three similar drawing machines thereafter. At each drawing two overlapping slivers enter each of the six (sometimes four or eight) divisions of the machine, but are so much drawn out thru the gills that but one sliver is usually produced from the first or second drawing, altho the third yields two to each machine. Thus to secure evenness of the yarn or thread, the flax as laid upon the spreader has now been doubled 6 X 12 X 12 X 6, or 5184 times.

To produce finer yarn, the ratio of speed between the first and second pairs of rolls on each machine is increased, the greater draught giving a finer sliver. For fine work, also, finer pins are used, and narrower gills, therefore narrower slivers.

The flat sliver is next made ready to be spun into yarn. On a roving frame many slivers are at one operation still farther drawn out thru fine gills. Every sliver is then guided into a narrow but loose bundle of fibers, to which a slight twist is given as it is wound, making the roving a very loose yarn. Twisting and winding the roving are two separate operations which proceed simultaneously, and so require separate action on the part of the machinery. The spindle serves as a shaft for the bobbin, but the bobbin turns independently and slower than the spindle altho in the same direction, so as to wind the roving. The bobbin also turns faster and faster as it fills, that the roving may be wound with uniform speed and therefore with uniform strain upon the roving. All the bobbins rest upon a steel shelf, the bobbin board, which slowly rises and falls, so that the roving will be wound evenly upon all parts of the bobbin. The spindle has two arms which extend out a little farther than a distance equal to the radius of the bobbin, then down a distance nearly equal to its length. The roving passes thru an eye in the apex of the spindle, turns about one arm, and passes thru another eye at its end, then to the bobbin. As the spindle, or spindle flyer, rapidly turns, the roving is of course twisted, and while twisted is wound upon the bobbin.

In converting the roving into yarn, the flax fiber is untwisted, drawn out still more, then tightly twisted as yarn, or single-ply thread. A spinning frame is similar in its action to the roving frame just described. There are no gills, but the roving is drawn out as before between first and second pairs of rolls having different speeds. The bobbin is not driven independently here, but revolves by friction upon the spindle which forms its shaft, being retarded sufficiently to wind the yarn by a leather string, which bears against a groove in the bobbin's rim, and is pulled taut by a lead weight depending from its end.

Some yarn is spun dry. Wet spinning is also practiced, because when the roving is thoroly wet before the fibers are drawn and twisted, the loose ends of the fibers are incorporated in the yarn instead of flying free as fuzz. In wet spinning the roving passes into a tank of steaming hot water before reaching the first pair of drawing rolls. For shoe thread, used in handsewed shoes, the roving is dampened by contact with a felt roll that is wet with cold water. Damp spinning is used instead of wet spinning so that when the shoemaker breaks his thread preparatory to doubling and waxing it the thread will not break short off but will draw out to a fine end.

Tow, the short fiber combed out in hackling, passes thru a similar series of processes. Different tows are placed in layers in great bins, different mixtures being made for different purposes. The tow is then pulled down across the several layers, so as to secure equal amounts of each as it is removed for use. A tow card is a difficult machine to describe. It consists of a large central cylinder set with fine sharp teeth, and pairs of surrounding smaller cylinders with bent teeth, or pins, which revolve at different rates of speed. The tow is picked or combed from one to the other, so that when it is removed from the last roll it comes off as a fine, thin sheet which may be gathered into a sliver. The little book, "*The Story of the Cotton Plant*, published by D. Appleton & Co., New York city, gives a fuller description of a cotton card, which is similar to a tow card. The tow sliver passes thru three drawing machines, a roving frame, and a spinning frame, as does the flax sliver from the spreader. Yarns spun from tow and those spun from flax bear somewhat the same relation to each other as do woolen and worsted yarns.

After spinning, the yarn is wound from many bobbins to an equal series of skeins on a long reel, in readiness for various processes of finishing the yarn. The skeins are often boiled, washed, bleached, washed, soured, washed, boiled again, washed, oiled and soaped, wrung out, shaken out, dried, colored, and worked until soft and pliable—some fourteen or more operations. The first boiling is for three hours with caustic soda, which acts like soap to soften and remove all foreign matter, thus leaving the pure cellulose of the flax. The boiling also destroys all germs of fermentation, which would otherwise cause the yarn or twine to decay after it had become wet in use. The washing removes the softened foreign matter in preparation for bleaching. In washing, the skeins are placed loosely over square shafts which turn them in and out of the water.

In bleaching, chemicals, by the action of chlorine and oxygen, destroy the coloring matter, yet without weakening the strength of the fiber to more than a slight extent. Washing largely removes the chlorides, and a slightly acid bath in the sour boxes serves to neutralize any alkali left. The following washings and boiling thoroly remove all trace of the acid, which might injure the yarn if it remained. Oiling serves to soften the much washed yarn, and the soap gives a slight film to its surface which makes it smoother.

To remove the water, the skeins are placed in a steel receptacle, and this is revolved so rapidly that the water is thrown off thru perforations in the steel. The skeins are then thrown over short horizontal pins, and shaken and pulled to remove all kinks and straighten out the yarn before drying. The strongest yarn is that which has been dried slowly in the air. The skeins are hung on poles in rooms whose walls consist of shutters, which may be opened to allow the air to blow thru. In our climate, especially in winter, much yarn must be dried by artificial heat. Then powerful fans force air over coils of steam pipes into the drying rooms.

When dried, some yarn is colored in baths with aniline colors. The standards are so mixed as to give the desired tints and shades. All yarns when finally dried must be worked in some way, to soften them and remove their harshness. The coarse twines are thoroly pounded by beaters which resemble sets of pile drivers on a small scale. Heavy vertical wooden stamps play up and down over a soap-stone plate, and work the skeins as they are twisted and untwisted beneath them. Other yarns are passed between ribbed wooden rolls, whose angles fit into each other like cogs. The best yarns are hand pinned. Skeins are thrown over a smooth, horizontal pin which projects from a post; the workman puts a smooth, stout pin, or stick, thru the other end, takes it in his two hands, then vigorously twists and pulls the skein until it is softened.

While some of the yarn which is to be woven into cloth is now ready to be packed up and sent away, that which has to be made into thread and twine has to be handled several times yet. If for shoe thread, the skeins are wound off on to bobbins, then reeled as skeins again. This would seem needless, but it ensures smooth and perfect work in winding from the skein to the ball, in which form the thread is sold. Other yarn is wound on bobbins, then twisted into twine or thread of two or several ply, and again reeled off in skeins. Many twines may be separated easily into the strands of yarn that compose them. Some twines and threads are marketed in the skein, these being then neatly pressed into compact packages. Machine thread is usually wound upon pasteboard cylinders, ready for use on the shoe sewing machines; and most twines are wound into balls. The packing, shipping, and marketing of the product is, however, a story in itself.

Some of the most important products should be described. Much grain bag twine is made, and used on the wheat fields of the

Central States. Baling twine is used in sewing up bales, in hardware stores and for other like purposes. Sail twine was formerly made for sewing sails, but is now used in sewing up ham bags in pork packing plants, and for closing flour sacks in flour mills. Hose twine is used in making fire hose. Bookbinders' twine states its own use. Carpet yarns are made from tow, and serve for the warps, the woof or filling being woolen yarns. Fine yarns are produced for weaving into linen cloth. Linen floss for embroidery is made. Shoe thread is made for hand sewed shoes, and machine thread for the stitching and the sewing machines used in shoe factories. Machine thread is made by twisting together three to sixteen strands of wet spun yarn. The wet spinning avoids the fuzz on the outside of the thread, which might otherwise catch in the eye of the needle and break. Harness thread is twisted more tightly than that for shoes, as harness makers like to show the round of the thread in their work, while the thread in shoes should flatten out, to give a smooth surface to the foot.

But is this geography? Frankly, no! The relation of the different qualities of flax to the climates and peoples where they were produced was a geographical problem; the distribution of flax manufacture is a matter of geography; but the processes of manufacture are not strictly so. So full a study of processes as is suggested here is appropriate to the study of a few home industries, which shall then serve as types; but should not be undertaken for more than a very few of the most important industries unrepresented at home. These should include one textile industry, but preferably the manufacture of cotton or woolen goods rather than that of linen thread and cloth.

The sketch is intended to suggest the kind of description desirable as an accompaniment for sets of specimens offered in exchange by members of the Bureau. It is designed to aid the teacher to understand a set of flax specimens, and to effectively use them in making her pupils so acquainted with flax and linen that they may readily appreciate to the full the references to them in their text-books. The specimens will very largely serve their purpose if simply placed before the children accompanied by illustrations and a brief written description prepared by the teacher to fit the pupils' needs. The work would occupy a place and rank similar to that of the ordinary information about lands and peoples customarily given in geography. While not directly concerned with relations, thoro knowledge of a product or industry gives a realization of matters which it is the special province of geography to relate to other factors.

CHILDREN AND CONTOUR MAPS

BY RALPH P. IRELAND

One can use contour maps profitably with children of any grammar grade. There is little difficulty when proper care is taken. Only the work must be selected with as much regard to the child's age and ability as any other work. Moreover, he must be given a fair chance to learn what has been selected. If one will put himself in the child's place there is a possibility that he may conclude that there is less difficulty in understanding a contour map than the ordinary colored political map.

In order to begin rightly the child must see some contours either actual or miniature ones on a model. This may be made from clay, putty, wood, stone, etc. The substance does not matter particularly, but the contours must be so distinct that he cannot help seeing them. They must be accurate. The model should be durable enough to be used more than once. I have found that a model made of clay with contours of twine held in place by beads inserted when the clay was soft, to answer fairly well so far as effectiveness is concerned.

When once the meaning of contours is grasped by a child, he will find that out of door illustrations are not rare. The lines marking the layers in a sand bank, particularly if excavation or erosion has left a part of it detached from the rest so that the lines may be followed all around, and also the lines marking high water and low water along the coast are illustrations that come readily to mind. The child who plays in a crowded city street may stop to notice the lines in a melting ice fragment, before he breaks it into smaller fragments on the curb-stone. The country boy will know where the sheep have terraced a hillside with contour-like paths while feeding.

The teacher who is just starting with contours is most fortunate if she has a map of the immediate locality to present at an early stage. Lacking this, one showing detached hills or mountain peaks would naturally be the next lesson.

Now as to the method of using the maps with a large class. Under average conditions it is hardly possible to have duplicates enough for each child. Nor is it wholly desirable except at first. Yet each child must have a fair chance to see the map if he is to be benefited. If it is held up before the class or used as a wall map he does not get this chance. A good way that will readily suggest itself to any teacher is to divide the class into groups. One group gathers about her for study for five or ten minutes and is followed by another till each child has studied the map at short range under the immediate care of the teacher. This takes time but none of it is wasted.

Right here is a good place to ask what is gained when the meaning of contour maps is thus carefully taught. Before answering one must consider what the maps are. The term contour map, as here used, refers to the topographical sheets published by the United States government. These sheets in addition to topography show drainage in detail and, either directly or by implication, a greater or less amount of climatic, commercial, and historical matter, as well as some other things. The mere locating of the area covered by one of these sheets upon the ordinary text-book map, showing a state or group of states, is of no small value. I know of nothing that will give a New England child so good an idea of the immense size of the western states as the discovery that the area covered by the sheet he has been studying occupies no larger space upon the map of California or Montana than may be covered by the end of a lead pencil or a school crayon. If one wishes to show the aridity of the Colorado Plateau, how can he do it better than by pointing out upon the Las Cruces sheet a river without branches, tiny intermittent streams "ending nowhere," and water-holes ten to twenty miles apart? How can you give a satisfactory idea of a delta without the East Delta (La.) sheet? Or the work of glaciers without comparing some Adirondack or White mountain sheet with some West Virginia sheet? To give a glance at history. Can you teach the colonial wars or Burgoyne's campaign without some of the Lake George and Hudson river sheets? Or the Civil War without the Shenandoah valley and Harper's Ferry sheets?

It soon becomes evident to the teacher who is faithfully striving to teach from contour maps, that, however well or poorly her class is growing in knowledge, her own conceptions of regions more or less distant, are being modified and improved at a surprisingly rapid rate. Any one living in a New England manufacturing village or city would probably claim to have a fairly good knowledge of rivers. Let such a one study a map of the Uvalde (Tex.) river or of the Platte, and this assumption would have a slightly sounder basis in fact.

The chief hardships in the use of contour maps occur at the start and are caused by progressing faster than the children can follow. Those that occur later are generally due to the facts selected not being adapted to the grade. A pupil in one of the lower grades can learn the shape of a delta, and the meaning of distributaries, or see that one place has great plains while another is covered with hills. One in the higher grades can see why the mountaineers of the Appalachians have not been able to progress so rapidly as the people of the Ohio valley. Every grade can find some work that is fitted to it. The wise teacher will keep a sharp lookout to distinguish between that which is acquired readily and that which is too difficult. *Much can be learned by comparison of maps which cannot well be acquired by separate inspection.* Do not show for comparison in any matter of topography a map having contour intervals of 250 feet and one with twenty-five foot intervals. It may however be done to infer a difference in rainfall.

The foregoing remarks are all written with the sole purpose of encouraging any teacher who has not already done so, to try what contour maps will do for her own knowledge and for that of her pupils.

THE PHYSIOGRAPHY OF CALIFORNIA

BY HAROLD W. FAIRBANKS

That portion of the Pacific Coast region embraced within the state of California is characterized by a remarkable diversity in its topographic features. The relative position of the mountain ranges, valleys, and plains, and the direction of the prevailing winds have given rise to great contrasts in climatic conditions as well as a variety of productions. Regions of excessive heat contrast with those of perpetual snow; regions of humidity with those of aridity; while broad valleys devoted to fruit and grain adjoin mountains filled with the precious metals.

For the full understanding of the physiography of a region, the student must know something of its geological history. How especially true this is of California will appear in the course of this paper.

Physiographically, California cannot be treated as a whole. It is divided often by sharp lines into strongly contrasting provinces which have been subjected to different conditions, and exhibit different types and phases of physiographic development. In one portion volcanic features, often but slightly modified by erosion, predominate; in another those characteristic of recently uplifted mountain blocks; in another forms of mature or far advanced topography; and in still another those resulting from coastal elevation or submergence.

No other state in the Union contains more interesting material for the study of physiography, and for observing the bearing of this upon human life, than does California. Geography should here attain a full and symmetrical development.

GENERAL PHYSIOGRAPHIC FEATURES OF THE PACIFIC SLOPE

The important features of relief of the Pacific coast region have a general north and south direction varying in places near the coast to northwest and southeast. These are a result of structural conditions.

We may distinguish in a broad way four physiographic divisions as we pass from the Rocky Mountains westward to the Pacific ocean.

(1) The Great Basin and Plateau region. Nevada and the eastern portion of California lie in the Great Basin, while eastern Oregon and Washington is occupied by a vast elevated tract continuous with the Great Basin and known as the Columbian plateau.

(2) These areas are bordered upon the west by an almost continuous mountain block of great magnitude, embracing many of the highest peaks in the United States. In California where this range reaches its greatest elevation it is known as the Sierra Nevada. In northern California, Oregon and Washington it is termed the Cascade Range.

(3) West of this line of mountains lie the most important valleys of the Pacific Slope. The largest of these embraces the San Joaquin and Sacramento valleys, known altogether as The Great Valley of California. This valley extends in a direction a little west of north thru the heart of the state. Similarly situated in Oregon is the Willamette valley; and in Washington, the large valley partly submerged by the waters of Puget Sound.

(4) Separating this line of valleys from the Pacific ocean there is another series of mountains fully as continuous as the Sierra Nevada-Cascade block, tho less elevated, and designated in general terms as the Coast Ranges.

Different portions of the Coast Ranges are known under different names. In Washington there are the Olympic mountains; in northern California and Oregon the Klamath mountains; and thru California many other local terms which will be given later.

At the southern end of the Great Valley the Sierra Nevada mountains blend with the Coast Ranges in a complex group. Continuing easterly beyond this point the Coast Range axis is known in a broad way as the Sierra Madre mountains. South of San Bernardino the designation Peninsula Range is applied to those mountains which extend southerly into the peninsula of Lower California.

GEOLOGICAL HISTORY AS RELATED TO THE PRESENT TOPOGRAPHY

We trace the beginnings of the broader features of the present topography far back in Tertiary time. Altho the mountain axes of the California region were outlined at a much more remote period yet those processes which developed the peneplain, the remnants of which are to be distinguished upon the mountain summits over much of the state, seem to have carried on their work thru the middle and late Tertiary.

The geography of the state near the close of the Miocene was very different from that of the present day. The ocean filled the Great Valley and spread over large portions of the Coast Ranges. The Lassen's peak volcanic ridge which now connects the Sierra Nevadas with the Cascade Range was not in existence at that time and the Sacramento valley was consequently open at the north. A series of more or less connected lakes of fresh water stretched at about ocean level across northeastern California into southern Oregon. Thru a protracted period of erosion, not without interruptions, the Sierra Nevada Range had been reduced to one of low relief. The streams flowed sluggishly in broad valleys, and the climate and vegetation were quite different from that of the present day.

The Klamath mountain region was probably an island at this time. It had also been worn down and a peneplain similar to that in the Sierra Nevadas extended over much of it.

Remnants of an ancient peneplain also appear upon the mountains of southern California. They exhibit about the same degree of degradation and are to the best of our present knowledge referable to the same period as those in northern California.

Toward the close of the Miocene period important mountain making movements affected the region of the Coast ranges. Protracted erosion followed the uplift. Then subsidence took place with the deposition of extensive beds whose position is on the border land between the Miocene and Pliocene. After the deposition of these beds uplift and folding again occurred. Then the Coast ranges appear to have been submerged again with the deposition of beds, both fresh water and marine of Pliocene age.

The movements of the central Coast ranges were undoubtedly felt in the Klamath mountains and in the Sierra Nevadas, but we have not there the criteria to distinguish them as certainly. There were intervals of renewed cañon cutting in these latter regions but the sum total of the results seems to have been a continuation of the base leveling.

A large part of the Pliocene was probably a period of depression in the whole Pacific coast region. The Coast ranges were however not as completely submerged as in the Miocene, and there are reasons for believing that the oldest recognizable peneplain remnants date from this time.

Extending south from the Klamath mountains nearly to San Francisco bay there is an ancient plain truncating the mountains. During the Pliocene it received the finishing touches as did also that upon the Sierra Nevadas and in Southern California.

The north and south mountain blocks of the Great Basin region may have originated during Cretaceous time; but toward the close of the Tertiary renewed movements affected them. The Sierra Nevadas were raised by a tilting of the block until it reached a hight perhaps as great as the present. Similar fault movements must also have disturbed the Coast ranges, in places breaking up the Pliocene peneplain. Volcanic outbreaks were associated with the movements of late Tertiary time. At the northern end of the Sierra Nevadas the outpouring lava filled up the depressed basin and formed the Lassen's peak volcanic ridge. Farther north they built up the great Cascade platform.

Volcanic action at several distinct periods filled up the ancient river channels of the northern Sierra Nevadas forcing the streams to seek new ones. Volcanic action also occurred in portions of the Coast ranges upon an extensive scale and upon the coast islands. Thus we find that near the close of the Tertiary period the geographic features of the Pacific slope underwent a radical transformation.

Erosion actively took up the task of destroying the newly elevated mountain blocks. In the Sierra Nevadas, Klamath mountains, and in the Sierra Madre of southern California the great cañons of the present day were begun. Erosion went on actively also in the Coast ranges and the details of the present drainage were worked out, but here the larger valleys of the present day were already in existence. They originated in part during the folding at the close of the Pliocene, and in part earlier as a result of the combined influence of structure and erosion. The whole region under discussion must have attained an elevation greater than the present and maintained this elevation until the cañons had attained nearly their present proportions.

Concomitant with this elevation, and perhaps as a result of it, the Sierra Nevadas, Klamath mountains and Cascade range became glaciated. The scouring of the ice modified the mountain topography somewhat, especially the cañons, leaving as a heritage to the present day the hundreds of basins in which lie the beautiful lakes so thickly scattered thru the high Sierras.

The Glacial period was followed by a general depression until the Coast ranges were submerged 1,000 to 1,500 feet below the level now existing. During the period of submergence partial peneplains were formed in different portions of the Coast ranges where the conditions were favorable. As the country began to rise the terraces which are so characteristic of the ocean front and of many of the river valleys came into existence. The movement continued until the coast was again several hundred feet higher than now. Finally came the last submergence drowning the mouths of the streams and giving rise to San Francisco bay.

These are, as far as they are known, the chief events which have left their impress upon the topography. From this brief outline it is not difficult to see that the topographic features of California are the result of many and diverse physical conditions. At the present time a discussion of the topography in all its phases can only be tentative. Much more investigation is necessary before we can be sure that we have a true story of even the recent geological events upon the Pacific coast.

TOPOGRAPHIC PROVINCES

For convenience of discussion the state will be divided into the following provinces: (1) The Sierra Nevada mountains, (2) The Great Basin region, (3) The Volcanic Plateau region, (4) The Great Valley of California, (5) The Coast ranges, (6) The Klamath mountains, (7) The Sierra Madre and Peninsula ranges, (8) Coastal features.

Some of the divisions here made are natural ones, others are assumed for convenience. For instance, the Klamath mountains, Coast ranges and Sierra Madre mountains constitute a continuous mountain axis the whole length of the state. The drainage features also are not defined by the boundaries of the different provinces. The Pitt river rises in the volcanic plateau region and crossing the axis of the Sierra Nevada-Cascade block joins the Sacramento in the Great Valley.

The Sierra Nevada Mountains. The Sierra Nevada mountains extend from about thirty-five degrees north latitude in a northerly direction, and finally a little northwesterly nearly to Lassen's peak in latitude forty degrees, thirty minutes; thus having a length of about four hundred miles and a width averaging nearly eighty miles. The highest portion of the range, and that which forms its watershed, lies very close to its eastern edge. For fully two hundred miles thru the central portion of the range this divide is seldom lower than 11,000 feet and scores of peaks attain an elevation of nearly 14,000 feet, Mount Whitney reaching 14,522 feet.

The range rises very slowly from the Great Valley upon the west but breaks off with exceeding ruggedness upon the east. Except toward its northern end this mountain range is practically a unit so far as its history is concerned. The elevation to the present great hight has been brought about thru the formation of a fissure or series of fissures at its eastern base. Upon their western side the mountain ridges descend practically to sea level, but owing to the long gentle slope the elevation of the range cannot be appreciated from that side. It is only when seen from the valleys at the base of the fault scarp that the magnitude of the range can be appreciated. Altho these valleys vary from 2,500 to 6,000 feet in altitude, yet the wall of rock forming the scarp rises so abruptly and with such colossal proportions that it is almost overpowering in its grandeur.

Upon the south the range has often been considered as terminating at Tehachapai pass with an elevation of 3800 feet, the mountains continuing to the west of the pass and connecting with the Coast ranges, being known as the Tehachapai range. The distinction thus made is immaterial to the main fact that topographically the Sierra Nevada mountains bend around the southern end of the Great Valley and connect with the Coast ranges.

The mighty eastern fault scarp in all its distinctness may be considered as beginning in the vicinity of Walker's pass, a low portion of the divide east of Kern Valley. With a gentle curve the mountain wall sweeps toward the north rising higher and higher for one hundred miles until culminating northwest of Owen's lake in jagged peaks of the Mount Whitney region. From this point for another one hundred miles northerly there is but a slight lowering of the crest of the range, altho the displacement by faulting which at the lower end of Owen's valley is as much as 10,000 feet, decreases to not more than 5,000 or 6,000 feet in the Mono lake basin.

As we approach Lake Tahoe the single fault zone is replaced by two, the ruggedness of the range gradually decreasing as Mt.

Lassen is approached. Lake Tahoe lies in a depression due to the formation of two fault scarps and the dropping of the eastern block. South of Honey Lake valley the scarp of the eastern block presents a bold front to the northeast fully 3,000 feet high.

As we approach Mt. Lassen the older crystalline rocks of the Sierra Nevada mountains disappear under the comparatively modern lavas of the volcanic plateau of northeastern California.

Viewed from the summit of the Inyo range lying to the east of the highest portion of the Sierra Nevada fault scarp the evenness of the crest of the latter is most remarkable. The great peaks like Whitney are not isolated as are those of the Cascade range but lose their individuality in the mass effect. This uniform sky line which appears as we view the mountains from a distance, becomes, as we investigate them more closely, but a cover for a complexity of cañons and gorges of great depth and picturesqueness.

If we discard the deep cañons, the peneplain character, of the crest of the Sierra Nevadas, appears most strikingly from almost any point giving a good view over extensive areas. Many of the highest peaks including Mount Whitney have flat or gently sloping summits bordered by precipitous walls. As one ascends the long gently inclined ridges of the western slope he is constantly reminded of an ancient plain now elevated and undergoing degradation. The evenness of this plain is often enhanced by the comparatively uniform surface of the old river beds which cap the ridges between many of the cañons of the central and northern Sierras.

The streams of the old peneplain before the re-elevation of the mountains, were choked with waste and mingled in this waste was the gold from the broken down quartz veins. Toward their headwaters the topography was undoubtedly quite rugged in places, but by far the greater portion of the western slope, thru continued erosion and the choking of the streams, was destitute of any marked relief. The older gravels date from the Miocene or earlier times and the discordance between these and the more recent ones indicated periods of disturbance.

The volcanic outbreaks inaugurated in late Pliocene were continued thru a considerable interval of time. The lavas flowed from fissures along the crest of the range near lines of disturbance. They increased in amount toward the northern portion of the range where the eruptions of mud, ashes, and lava flowing down the valleys completely buried them. The most remarkable flow remaining is that known as Table mountain. This is found in Tuolumne county and extends from the high mountains many miles down into the foothills. The country about it is now lower and many tunnels have been run under it to obtain the gold in the buried gravels.

The volcanic material deposited in the river beds whether fragmental or massive appears to have been quite resistant to erosion and so in many cases permanently displaced the old streams. In the southern portion of the Sierras there was little or no volcanic capping and the old channels have been practically removed since the uplift of the mountains. It is probable also that thru the central Sierras the uplift was greater than farther north, so that erosion would be more vigorous.

In the region of the high Sierras rise those streams whose cañons have made the scenery of these mountains famous. The Tuolumne, Merced, San Joaquin, Kings, and Kern rivers have eroded cañons 3,000-5,000 feet deep. The most noted of these are the Yosemite valley, Hetch-Hetchy valley, and Kings river cañon.

The most of the streams which have cut the great cañons have not yet reached a graded condition unless it be near the borders of the mountains where they emerge upon the plains of the Great Valley. Their banks are generally steep and but little bottom land exists along them. Near the southern end of the Sierras, however, as well as at the north, there are valleys of considerable extent seemingly pointing towards a longer existence of the present conditions in those regions coupled with a lesser amount of uplift. At the south the Kern valley is a notable example, while the Sierra valley at the north is even larger in extent.

The drainage of the eastern slope of the Sierra Nevada mountains is short, but the streams descend with great velocity to the valleys of the interior basin. The larger ones are Owens, Walker, Carson, and Truckee rivers.

The formation of a double fault block from a point a little south of Lake Tahoe has given rise to the Tahoe-Sierra valley thru a partial dropping of the eastern block. The eastern face of the latter block gives rise to the bold mountains southwest of Honey Lake valley. In the Tahoe-Sierra valley, close under the fault scarp of the western block, lie Lakes Tahoe, Donner, Independence and Weber. These are all drained by the Truckee river which flows easterly and northerly across the dropped block, reaching finally to Pyramid lake in the Great Basin.

THE YOSEMITE FALLS.

Lake Tahoe is the largest of the bodies of water along the base of the fault scarp. It is one of the most beautiful lakes also of the whole Sierras. It owes its existence to a lava dam formed across the ancient valley of the upper Truckee river. This fault scarp extends north of the lakes bounding Sierra and Mohawk valleys upon the west, but gradually disappears. This has permitted

Feather river to extend its basin eastward so as to drain both the valleys mentioned westward into the Sacramento.

Waterfalls of great hight and beauty are frequently found where the smaller streams join the main rivers, as in the case of those in the Yosemite valley. The fairly uniform hardness of the rocks, chiefly granitic over large areas, has resulted more often in swift rapids than in waterfalls.

The gold bearing belt upon the western slope of the Sierra Nevada mountains is known world-wide. The Mother Lode, a series of gold bearing quartz veins extending for more than 100 miles thru the foothills, exhibits in places such large bodies of quartz as to have had considerable effect upon the topography. The system of fault plains running parallel to the range thru the mineral region has, in connection with dikes of igneous and metamorphic rocks of varying hardness, determined in great measure the courses of the smaller streams in the western or foothill belt. They exhibit a fairly complete adjustment to such conditions, but the main courses of all the larger streams are consequent upon the slope of the mountains.

From the relation of the glaciated surfaces to the present cañons it is believed that the latter were largely excavated before the Glacial period. It is probable that the ice during this time nowhere reached much below 4,000 feet in the Sierras, while toward their southern end 8,000 feet was the limit.

The higher portions of the mountains were swept bare of all loose and disintegrated material by the ice, and the harder rocks, generally granitic, were finely grooved and polished. Glacial moraines are particularly well shown upon the eastern slope where the ice streams passed out of the cañons on to the edge of the desert basins. Vast quantities of fragmental material thus encumber the mouths of many cañons and in some cases have given rise to beautiful lakes. The basins at the heads of the streams often exhibit very finely the characters of glacial cirques, being walled in upon their upper sides by nearly precipitous cliffs 1,000-2,000 feet high. The cañons descend by successive steps from these cirques at their head to a point near the foot of the fault scarp. Many of the basins are occupied by lakes which are either entirely rock rimmed or inclosed upon their lower edges by morainal walls.

The rolling, rock-ribbed surface of the high Sierras is fairly dotted with glacial lakes. These elevated regions with their bare and polished rocks appear to have been glaciated so recently that it has been thought that the Glacial period was later here than in the eastern portion of the continent.

Various explanations have been given to account for the remarkable features of the Yosemite valley. This valley lies in the heart of the Sierras and ~~is~~ traversed by the Merced river which enters it by a series of rapids and waterfalls, and leaves by a narrow cañon. The valley floor, which is about three-fourths of a mile wide and eight miles long, has an elevation of 4,000 feet, while the mountains enclosing it rise 3,000-5,000 feet more. Some portions of the inclosing wall are practically vertical to hights varying from 3,000-4,000 feet. The Yosemite creek enters the valley in three falls measuring altogether 2,700 feet.

EL CAPITAN, YOSEMITE VALLEY.

A study of the structure of the granitic rock of the region shows that it is traversed by systems of joint-planes. Where these are inclined the walls are sloping, but where the main system is vertical the agents of erosion, water and ice, have widened the cañon to a valley with steep or vertical walls. It is also probable that where the valley lies the rocks were exceptionally fissured and thus more readily disintegrated and eroded. This joint structure in the granite has controlled much of the detail in the scenery of the whole Sierra Nevada range.

Portions of the granite of the high Sierras, especially in the vicinity of the Yosemite and Kings river cañon, weathers out in great dome-like forms. This is undoubtedly produced thru concentric weathering in portions of the rock not so permeated with joint planes. The great south dome of the Yosemite is a typical example.

The same agents then which have produced the great cañons have given rise to the Yosemite, only here they have been aided by exceptional conditions in the rocks.

The Great Basin Region. In the early Cretaceous the Sierra Nevada and Great Basin ranges were not in existence. It is believed however that the region as a whole was considerably elevated but owing to earth strains was at last brought into a condition of unstable equilibrium. This resulted in the formation of north and south fissures and the whole region between the present Sierras and the Wasatch range broke up into a series of crust blocks. The crust blocks moved upon each other, some sinking, others rising. The depressed one gave rise to the valleys, the uplifted ones to the mountain ranges. Movements along these fault fissures have continued at times to be manifested down even to the recent period. As late as 1872 displacements as great as forty feet took place in Owen's valley and at other points thru western Nevada.

The disturbances which elevated the Sierra Nevada mountains at or near the close of the Pliocene probably also affected many other ranges of the Great Basin, for the fault scarps of many of them are fully as abrupt as that of the eastern face of the Sierras.

The valleys of the Great Basin are generally hot and arid. They range in elevation from that of Death valley, about sixty-nine feet below sea level to 6,000 feet above. The mountain ranges are high, many of them reaching an elevation of 10,000 feet. The Inyo and White mountain ranges attain an elevation in places nearly equal to that of the Sierra Nevada, White mountain peak at the extreme northern end of the latter range towering to 14,000 feet.

That portion of the Great Basin within California exhibits two distinct phases of topographic development. (1) That lying east of the Sierra Nevada. This is typical of the Great Basin as a whole; that is, it is characterized by arid or semi-arid valleys inclosed between high and rugged north and south mountain ranges. (2) That in southeastern California lying between the Sierra Nevada and Sierra Madre ranges, and including the Colorado desert. The northern part is an elevated region known in general terms as the Mojave desert. It is characterized by a lack of recently faulted crustal blocks and has an irregular mountain structure. The mountains are low and nearly buried in their own waste, which has accumulated for a long time in the inclosed basins. This latter region is typical of an old topography and may with reason be considered as an illustration of how the Great Basin would appear as a whole if it had not been broken up by faulting.

In discussing the features of the Great Basin in detail, the portion exhibiting low relief will be taken up first. The basin of the Colorado desert is separated from the Mojave desert by a low range of mountains forming the southeastern continuation of the San Bernardino range. The Colorado desert is in simple terms the northern portion of the depressed area occupied by the Gulf of California. It has been gradually cut off from the gulf by the delta material brought down by the Colorado river. The lowest portion at Salton lies 260 feet below the level of the sea. A portion of the Colorado river during stages of high water is frequently diverted thru a channel known as New river. This latter river runs northerly and if the water is sufficient reaches the Salton basin, forming a broad and shallow lake. It cannot have been a very long period since the basin was occupied by a permanent sheet of water, for the old shore lines are very distinct. Extensive salt works are situated at Salton, the salt being scraped up from the deposit covering the surface of the basin.

The area of the Mojave desert is somewhat triangular in shape. It is between 200 and 300 miles wide from north to south along the eastern border of the state, but gradually narrows westward as the Sierra Nevadas and Sierra Madre approach each other, and terminates at their meeting point. The area is sharply marked off upon the south by the Sierra Madre mountains, but upon the north the irregular ranges gradually give place to the north and south fault ranges. This region is hot and exceedingly arid except toward the western end, where a portion known as Antelope valley receives some rainfall.

Many lake basins dot the surface of the Mojave desert. During the Glacial period these were filled with shallow bodies of water, but now they are dry and expose vast stretches of yellow clay. The only stream which penetrates the desert is the Mojave river. It rises upon the northern slope of the San Bernardino range and finally sinks in the center of the desert.

The most impressive feature of this region is that of the long waste slopes which center about the scattered mountain peaks and slope away for miles in every direction, terminating upon the borders of the ancient lake beds. Over wide stretches the mountains have nearly disappeared beneath these waste slopes, rising only as small rocky knobs browned under the influence of the intense heat of summer. Toward the eastern edge of the area there are higher mountains, but the waste slopes are fully as prominent. Pilot knob reaches a hight of 5,500 feet, but the most of the valleys vary between 1,800 and 2,500 feet.

The topography illustrates most excellently the conditions which finally arise in the course of the degradation of a mountainous region from which the waste cannot be removed because of the lack of an outlet. It also illustrates the effects produced by erosion in an arid climate. What little rain there is comes in sudden and severe storms at rare intervals. The rush of water sweeps the debris from the mountain cañons out upon the valleys at their mouths. There the waters no longer confined spread out and drop their load in the form of debris fans or cones. These coalescing when the cañons are near together give rise to the long and gentle slopes.

The immense quantities of fragmental and rudely stratified material forming the even slopes clustered about the peaks, and leading down to the inclosed basins or sinks, impresses one with the power of the destructive agents. Everywhere the desert seems a region of waste and desolation.

Recent volcanic action has occurred at a number of points. Finely shaped lapilli cones, and long winding flows of black basaltic lava free from soil and unmodified by erosion, are characteristic forms.

The lake basins upon the northern edge of the area were supplied during the Glacial period with water from the melting snows upon the Sierra Nevada mountains. The great Borax marsh, whose surface is now whitened almost as far as the eye can reach by the efflorescence of different salts from the moist clays beneath, was then occupied by one of these lakes. The marsh is partly inclosed by mountains upon whose slopes are still well defined beach lines of the ancient lake.

We pass by degrees from the structureless region of old topographic forms to that upon the north, where the north and south fault lines give place to rugged and often youthful forms. At the southern portion of the latter region are the Panamint, Amaragosa, Coso, and Slate ranges. The highest of these is the Panamint, which at one point reaches an elevation of 10,000 feet. These mountains do not occur as isolated blocks, but sending off spurs interlace so as to give rise to valleys more or less separated from each other. The mountains rise to a hight sufficient to give them a light rain or snowfall and are covered, about their summits, with a scanty growth of nut pine. There is scarcely any precipitation in the valleys but occasional springs occur near the edges of the valleys. They are undoubtedly connected with the fault fissures. Death valley is the most widely known of all these depressions. It has a length of about fifty miles and a width of ten. The center of the valley lies below the level of the sea. The great stretches of alkali flats in this valley acquire an intense heat during the summer days, and have proved disastrous to many a prospector.

Panamint valley, upon the opposite side of Panamint range from Death valley, is nearly as large, but has an elevation of 1,300 feet. Farther west and across the Argus range is Salt Wells desert, reaching up to the base of the Sierra Nevada mountains. The waste slopes in some of these valleys have spread out so far as to nearly or quite obliterate the alkali beds of the former lakes.

Toward the southern end of the area under discussion the mountain slopes are more dissected and do not show such marked indications of recent movement. To the north, however, lies the Inyo-White mountain range, having a length of nearly 100 miles. Thruout much of its length, especially upon its eastern side, this mountain block presents a fault scarp nearly as high and fully as precipitous as that of the Sierra Nevada mountains. Upon the western border of Saline valley, which lies at the eastern base of the Inyo range, the latter appears to have undergone marked elevation in very recent times. The borax marsh in the bed of the valley lies close under the bold eastern front of the range. The displacement here must be between 8,000 and 10,000 feet.

Owens valley is one of the most interesting basins of eastern California. It occupies the enormous sunken area lying between the Sierra Nevada range and the Inyo-White mountain range. At the southern end of the valley is Owens lake, one of the largest of the remaining basin lakes of California. It has an elevation of 3,700 feet and lies close under the fault scarp of the Sierra Nevada range. The depressed crustal block, or rather blocks, forming the valley extend northerly from the lake for about 80 miles with a width of 10 miles. Owens river traverses the valley, rising in the Sierras opposite its northern end and emptying into the lake. Many small streams enter the valley from the west and are used for irrigation. How completely the Sierras cut off the moist winds is shown by the fact that altho the Inyo and White mountain ranges in places rise nearly as high, yet the precipitation upon them is very light.

During the high water stage of the Glacial period Owens lake overflowed its basin. The waters poured thru the long depression extending southerly from the lake and close under the Sierras, and passing the narrow gap where the Coso mountains come so close to the Sierras, emptied into Salt Wells desert.. From the latter region they spread to the borax marsh already described. The ancient bed of this now dry river corresponds in hight to the uppermost terrace of Owens lake. The river was fully 1,000 feet wide and its ancient channel is now followed for thirty miles by the wagon road from Mojave to Owens valley.

Running thru the middle of the Owens valley depression and toward its southern end there is a line of hills called the Alabama hills. These have an abrupt front to the east rising 200-300 feet above the sandy river bottom. This shows that the valley is divided into at least two longitudinal blocks, the eastern one having been dropped more than the other. As a feature of the earthquake of 1872 a new fault line was formed in the valley near this scarp, the valley dropping 10-40 feet more.

Volcanic flows and cinder cones mark the line of displacement in Owens valley at several points. North of the town of Bishop at the upper end of the valley a broad table land of volcanic ash commences and extends many miles in the direction of Mono lake. The table land gradually rises to a low divide and is then replaced by low ridges of rhyolitic lavas, between which are extensive plain-like valleys covered with loose volcanic ashes.

Owens river has cut a cañon thru this plateau fully 1,000 feet deep. Along the summit of the valley, between Owens valley and Mono lake, the lavas have been piled up so as to nearly obliterate the fault scarp. As we approach Mono lake it again comes out very boldly, and at the lake the fault scarp, tho much eroded, is about 5,000 feet high. The settling of the basin in which Mono lake lies has forced the water close up under the scarp. Here also a recent movement has occurred, as shown at the mouth of Mill cañon by a wall of earth 40 feet high.

The region about Mono lake has been the theater of many volcanic outbreaks and earthquake disturbances. The islands in the lake are fissured and shattered, while upon the north shore of the lake at Black point there are open earthquake fissures.

Extending south of the lake for a distance of 10 miles there is a group of remarkable volcanoes known as the Mono craters. These have been formed thru the piling up of viscid lavas and vast quantities of pumiceous ash. There are craters here formed by explosions merely, by the piling up of ashes about an orifice, and by the upwelling of viscid lavas. Several of the craters from which pumice was at first blown were afterward the scene of outpouring lava. In two or more instances the lava cooled before overflowing the older crater of ash. These features have been unaffected by erosion and remain almost as perfect as when formed, making the region one of exceptional interest.

The waters of Mono lake, like those of Owens lake, are intensely alkaline. Judging from the terraces, the lake did not overflow its basin during the Glacial period.

For some distance north of Mono lake the fault scarp of the Sierras is less bold and the region is largely covered with andesitic lavas. In these lavas occur the noted gold-sliver deposits of Bodie. Continuing toward Lake Tahoe we cross the valleys of the Walker and Carson rivers, which near the mountains are well watered and highly cultivated. After traversing a number of valleys the Walker river empties into Walker lake and the Carson spreads out in a sandy waste known as the Sink of the Carson in west central

Nevada. The Carson valley just over the line in Nevada is one of the largest and most fertile of the farming regions of Nevada.

Lake Tahoe has already been described in connection with the Sierra Nevada mountains, altho its drainage thru the Truckee river is into the Great Basin. This lake, with an elevation of 6,225 feet, but 200 more than Mono lake, is a sheet of pure cold water, contrasting strongly with the latter.

During the Glacial period a great lake called Lahontan spread over the now desert basins of northwestern Nevada and into the edge of California. A large remnant of this lake remains to the present day at the foot of the fault scarp in northeastern California. This body of water is known as Honey lake and has an elevation of about 4,000 feet. At present it has no outlet and is of course alkaline.

The Volcanic Plateau Region. The northeastern part of California is an extensive plateau region broken by numerous ranges of mountains. Under the above head will be discussed all that area lying east of a line connecting Shasta valley with the northern end of the Sierra Nevada mountains. The Lassens peak ridge and the line of extinct volcanoes reaching north to Mount Shasta and connecting with the Cascade range of Oregon have been included by some, and perhaps justly, in the Cascade range. The volcanic peaks undoubtedly do form a continuation of those of the Cascade range in Oregon, but thru northern California this range, aside from the scattered peaks, can scarcely be distinguished from the volcanic plateau region to the east. It is, in fact, continuous with that plateau.

The plains and valleys of this region have an elevation of 3,300 to 5,000 feet, while some of the mountains, exclusive of the volcanic peaks, attain a hight of 10,000 feet. The region is made up almost wholly of volcanic rocks, and is structurally as well as historically closely related to the northern portion of the Great Basin and the plateau region of eastern Oregon.

The greater portion of the area is fairly well watered, for the mountains on the west are not high enough to cut off the moist winds from the Pacific. Irrigation is, however, often resorted to, and in the extreme northeastern part the long fertile valley known as Surprise valley is largely dependent upon irrigation.

Numerous lakes, some of them of large size, are scattered over this region. They are remnants of much larger ones of the early part of the Pleistocene period. Upon the borders of the area are several lakes without outlet, which might properly be included in the area of the Great Basin. These are Tule lake upon the borders of Oregon, and the Surprise valley lakes.

The major portion of the area is drained by Pitt river, the most important tributary of the upper Sacramento. Many of the valleys which Pitt river traverses, such as Fall River, were once occupied by lakes. The lakes were finally drained, partly perhaps as a result of mountain movements, and partly thru stream action. Pitt river in its upper course passes alternately thru broad plain-like valleys and deep cañons. The lake of Fall River valley had apparently no very high barrier upon the west. The lowest portion of this barrier is now traversed by Pitt river in a gorge of considerable depth and ruggedness. The extreme source of this river has been Goose lake, a large body of water lying partly in Oregon, but at the present time the waters of the lake seldom rise sufficiently to cause an overflow.

The Surprise valley lakes are shallow, and during some seasons almost wholly dry up. Eagle lake, in the southern portion of the area, has no surface outlet, but there must be one underground, for the water is perfectly pure.

Tule or Rhett lake is interesting in many respects. It together with the Klamath lakes formed one large body of water until Klamath river cut its present cañon and partly drained the old basin. Tule lake now has no surface outlet, but the waters are fairly fresh. Klamath river during stages of high water has until recently been partly diverted to Rhett lake, but this no longer happens. The region about the lake is quite arid and few streams enter it.

Interesting drainage features are associated with the recent extensive flows of lava. In such areas there is generally little surface water, but underground streams are frequent. Rugged lava fields stretch from Tule lake south into the upper end of Fall River valley. Much of this lava at least was formed since the lake period and altho vegetation has gained a foothold upon its surface, yet the rocks are quite free from soil and exceedingly rough. The surface of the flow contrasts strongly with the deep soil and heavy forests about it. Fall river bursts out in numerous large springs from beneath the end of the lava flow, and after winding sluggishly thru the valley for 15 miles enters Pitt river thru a series of swift rapids. The river has a very small local drainage and never varies in size between winter and summer. Hat creek is a similar stream, which enters Pitt river from the direction of Lassens peak.

The mountains rising from this plateau region are mostly due to one of two causes, either the piling up of eruptive material or faulting. The physiographic history has certainly been a complicated one. The older mountains of the region exhibit no regular arrangement and have been much modified by erosion. The Warner mountains bounding Surprise valley upon the west constitute the best example of the Great Basin type of elevations in northeastern California. They extend north and south for about 70 miles, rising to about 10,000 feet elevation in the highest portion. They present a bold scarp to the east and a long gentle slope upon the west. This fault scarp has been deeply sculptured by erosion, and owing to the tuffaceous character of a portion of the lavas of which it is composed, often presents picturesque castellated forms.

Recent fault movements appear to have taken place along the base of the Warner range. The features produced by similar movements are to be found over many other portions of this plateau region. These consist of long lines of bluffs extending northerly and southerly with scarps 100 to 200 feet high. These perhaps more frequently face the west and traverse all but the most recent of the lavas.

The volcanic rocks of the greater portion of this plateau region have undoubtedly issued in a molten condition from fissures in the crust and not from definite centers like those which result in volcanic peaks. The line of great volcanic peaks stretching from the northern end of the Sierra Nevada range northward into Oregon grew up toward the close of the long period of igneous action, probably in the later Pliocene. They undoubtedly vary in age and have time and again been modified by new eruptions. Some are greatly dissected by erosion while others are comparatively intact.

Under the greater peaks we will include Mt. Lassen, Crater peak, Magee peak, Burney butte and Mt. Shasta. Lassen peak rises to a hight of 10,437 feet and is the center of an exceedingly interesting volcanic region. Cinder cone, a little to the northeast, was the scene of what was probably the most violent volcanic eruption in California. Judging from the tree trunks still standing in a field of volcanic ashes, this eruption could not have been more than two hundred years ago.

Burney butte is the most perfect of the larger volcanic peaks. It rises to a hight of 7,880 feet.

Mount Shasta reaches an elevation of 14,350 feet being next to Rainier, the loftiest peak of the Cascade range. Tho but a little lower than Mt. Whitney it presents a far more imposing appearance owing to the low mountains and open valleys which surround it. Strawberry valley at its southwestern base has an elevation of 3,550 feet and from this valley as well as from others upon the west and south the mountain presents an appearance so striking and grand that when once seen it can never be forgotten. Its summit, snow covered thru the year, with the dark forest encircling it below, is ever a feature of fascinating interest. Since the glacial period, lavas have issued from its sides, and one stream flowed for more than fifty miles down the cañon of the Sacramento river. Small glaciers still remain in sheltered depressions. The melting snows furnish water for a number of underground streams which break out in the cañons of the Sacramento and McCloud.

To the west of Shasta there rises a very perfect cone known as Sugar Loaf or Black butte. It towers over 2,000 feet above the valley.

In addition to the great volcanoes already described there are hundreds of smaller ones scattered over this region. The large volcanoes have been built up thru a combination of massive flows and fragmental material blown out. The smaller ones are almost all lapilli cones and generally do not rise more than 100 to 500 feet. They have steep slopes and crater-like depressions in their tops. They represent the last expiring forces of the volcanic period.

(To be continued.)

EARLY CONCEPTIONS CONCERNING THE EARTH AND NATURAL OBJECTS

BY FRED HARVEY HALL CALHOUN

As far as logical presentation is concerned the science of physiography is young, a mere child; but in its essentials it is as old as Adam. It had its birth with the first reasoning animal. Low in the scale as that animal was, he was nearer to Mother Earth than his more civilized descendants. Stones were his weapons, skins of beasts his clothing, and caves or earth-holes his home. All that he needed came to him at first hand from Nature's abundance, and in return he invested all her phenomena with a close personal life. To this prehistoric man the rain was the tears of some offended goddess, or the milk from the storm cattle. It may not be uninteresting to trace the development of ideas concerning the earth and natural objects from such primitive conceptions thru the heroic age and the medieval period until with the expansion of mind attendant upon the Renaissance, is born a spirit more truly scientific.

The savage is, in one sense of the word, a true scientist; he is not only a close observer, but he is willing to explain everything he sees; that he is not always right should not count against him. In this groping for causes the primeval man stumbles upon an all satisfying explanation—the personifying of Nature; the sun, moon, stars, and even the stones and sticks of the field are thinking, sentient beings. Among some savage tribes at the present time a tree is never cut down without a prayer being offered to its spirit, for the savage expects to meet it some day in the Happy Hunting Grounds.

No natural object has been held in greater reverence among savage and half civilized tribes than has the sun. Indeed to the most civilized people the sun is almost an object of veneration for they recognize that abundant harvests, healthful bodies, and joyous spirits are alike dependent upon its beams. To the savage, however, the sun means everything. It forms the basis of his religion; it regulates his life. Among early races the sun was worshiped as the great god and giver of all, and even holds his place to-day in spite of the missionary. The sun and moon are usually regarded by savage tribes as good spirits, while night is considered an evil demon. Once a day this evil spirit is victorious but is vanquished by the sun every morning. Because they believe the evil spirit is gaining the upper hand they regard eclipses with the greatest awe and dread. They usually assist the sun in his fight by making terrible noises since the powers of evil are supposed to be very susceptible to noise of any kind. In Greek mythology the sun was a chariot driven by Phœbus. The story of the eventful ride of Phaethon, his son, is a familiar one. There is one tribe of Indians who, while they recognize the sun as a god, believe that he is not a very powerful one for he is tied and has to follow the same path year after year. If he were much of a god, they reason, he could go across the sky in any direction.

Another story of the sun explains how there happens to be no stars in the daytime. It seems that once upon a time both the sun and the moon had children. There came a time when there was a great famine in the heavens, and so the moon proposed to her sister the sun, that they eat their children. The moon hid hers in the darkness and said, "See, I have eaten mine." The sun then ate hers; but when she saw that she had been deceived, she was very angry, and began to chase her sister. Once in a while she catches her and bites a piece out of her cheek. By this story the Malays explain why there are no stars in the daytime and why we have eclipses.

The moon is not a mass of dead matter. One man, Anaxagoras, nearly lost his life for calling it such. It is the horned huntress, Artemis, or some other equally beautiful goddess, and many are the stories told of it. The spots on the moon have attracted the most attention. You remember that Hiawatha asked Nokomis about these spots when he

"Saw the moon rise from the water
Rippling, rounding from the water;
Saw the flecks and shadows on it;
Whispered, 'What is that Nokomis?'
And the good Nokomis answered:
'Once a warrior, very angry
Seized his grandmother and threw her
Up into the sky at midnight;
Right against the moon he threw her;
'Tis her body that you see there.' "

Some people see a man in the moon; others a man with sticks on his back, who has to stand there as a punishment for breaking the Sabbath. The people of this generation find there the face of a beautiful woman.

The stars are thought by some Mexican tribes to be birds with bright breasts and dark backs. When they face us we see the stars, but if they turn their backs they become invisible. When a bird flies over the face of the heavens we see a shooting star. Then again the stars are the bright nails holding up the sky, or the lamps hung out from heaven to light the lower world.

The savage ideas of the world as a whole are very curious. One of the most common beliefs is that the world is supported upon the head of a snake. The snake is coiled upon the back of a turtle and the turtle swims in a great ocean. When the turtle becomes so tired that he can swim no longer he will sink. World, snake and all will disappear. The world itself has been believed to be a turtle. The heavens correspond to the upper shell, and the lower shell forms the home for man. The earth has also been compared to an egg, the yolk being the earth, the white part the water, and the shell the sky. The early Scandinavians believed that the earth was a great giant, that the mountains formed his bones, the soil his flesh, and the rivers his blood. The Chinese believe the tides to be the pulsation of the world's blood, and other races consider them due to the breathing of the earth.

The sky, among many untutored peoples is looked upon as a solid dome of blue crystal; the clouds are believed to be snowy mountains. The Aryans had the same word for mountains as for clouds; among many nations the clouds are regarded as birds. The ancient Scandinavians believed the clouds to be boats flying between earth and heaven, bearing the dead from one land to another. Their heroes were always buried in boats so as to be ready to sail. In Altmark a penny is still placed in the mouth of the dead to pay his fare in the cloud boat.

Where the clouds are believed to be birds, there the lightning is the fiery serpent carried home to the young. To this day among some Canadian tribes the thunder is thought to be the hissing of these serpents. Where the clouds are mountains, the thunder is the crash as they come together, or the blow of the hammer of Thor or the spear of Odin.

One of the old Norse songs tells of a mill owned by a giant which turned out an unlimited quantity of gold and silver. The mill was worked by maid servants, and in the course of time, after the giant became avaricious and worked them too hard, they rebelled and ground out hate. This created such a disturbance that the whole thing was thrown into the sea by a Norse sea rover. It is there at the present day grinding out salt.

In the course of time from these conceptions there arose a more scientific account of the world. This account was not very scientific, viewed from our present knowledge of the subject, but it was a slight improvement on the turtle story. The people of India, Persia and Egypt believed the earth to be a huge table. The sky was made of metal and supported at each of the four corners of the table by a stone pillar. It was believed that when this earth was being made, one of the gods raised the sky and placed upon it the waters of the firmament. The rain was caused by the water from this ocean above the sky, and the stars were the lamps fastened to the under side of the sky to light the world by night.

The belief that the earth was made of two stories, one for men and the other for gods, has given rise to many curious legends. In these stories men are always trying to get to heaven and the gods are just as often frustrating their endeavors. In a Grecian story the giants tried to get to the home of the gods by building a high mountain. The gods conquered the giants, burying them deep in the earth. At the present day at Mount Ætna you can see the result of their efforts to escape. The Hindoos attempted to get to the upper world by means of a tree; the Jews by a great tower; the ancient races of Mexico have a story of the building of a great pyramid for the same purpose. Our story of Jack and the Beanstalk is another version of the same legend.

The views held by the early church were much the same as those held by the Egyptians. The church fathers interpreted the Bible literally. In the VIth century Cosmas, in a book which he called Christian Topography expressed his views of Physiography. He believed the earth was a parallelogram surrounded on four sides by the sea. Surrounding these four seas were four walls upon which the sky was cemented. This was a great improvement over the old conception that the firmament rested on four pillars, for then the sky might have slipped off its supports at any time. Upon the sky the angels lived. Their chief business was to keep the stars burning and the earth well watered thru the windows of heaven. Cosmas accounted for the movements of the sun by supposing that at the north was a great mountain behind which the sun was carried at night. His theory was widely accepted, but some higher critics objected to his disposal of the sun. They believed that it was lowered into a great pit at night and pulled out in the morning. Cosmas closes his treatise on the earth by saying that not only Moses and the prophets but even the angels and the apostles agree to the truth of his doctrine, and at the last day every one who does not believe his theory will be damned.

At the end of the fifteenth century a great discovery took place which completely revolutionized ideas concerning the world. This was the discovery of America by Columbus, and later the circumnavigation of the globe. Columbus was by no means the first man who believed that the earth was round. In the middle of the fourteenth century before Christ, Aristotle proved that the earth was round. Eratosthenes in the third century before Christ measured it and found its diameter to be 8,000 miles, a result so nearly correct as to be startling; but during the dark ages of early Christendom all this was forgotten and the views of Cosmas held sway.

During the latter part of the fifteenth century there was an attempt made to find a water route to India, and the first attempt was made by the Portuguese. They endeavored to reach India by sailing around Africa. Columbus attempted to do the same thing by sailing directly west and never knew that he had gone only half the distance but believed he had reached India. The greatest trouble these explorers had, was to conquer the terror the common sailor of that day had for the unknown parts of the sea. Many a bold sailor who was quite willing to brave storms and pirates had no desire to fall into one of the openings into hell which popular belief put into the Atlantic at some unknown distance from Europe. In a scientific book written in England in the form of a catechism about this time, occurs the following gem: "Why is the sun so red in the morning?" "Because it looketh down on hell fire."

The travelers of the fifteenth century knew of the great region of ice and snow to the north. They reasoned from this that to the south was a region where the ocean boiled and the land was inhabited only by salamanders. The sailors believed that should they once get into the hot zone they would be burned black. Another belief was that if they sailed too far away they could not get back. They could easily sail up hill but not down. When the belief became general that the world was round, the views of Cosmas were replaced by a new philosophy. The earth was taken as the center of the universe, and the sun, moon, planets, and stars revolved about it. It was the home of man and must be the center of things. Around this center of the universe were ten transparent spheres. Cemented in each sphere was a heavenly body and the sphere and the body was revolved about the earth by an angel. The tenth sphere enclosing all was immovable. It divided the created from the non-created world and was where God lived and listened to the music of the spheres. Below the earth was hell from which the bad angels sometimes escaped and caused storms, lightning, hail, and drought.

Copernicus was the first to attack this theory. Galileo followed; and soon the crystal spheres had to go. The sun was made the center of the solar system about which the earth and the planets revolved. This was not accomplished without a great conflict. Both men were declared heretics and nearly lost their lives. The following are some of the reasons advanced to show why the earth could not move:

Men and animals have muscles which expand and contract thereby causing movement. Search as you might you would not find muscles in the earth and therefore the earth was unable to move. They also reasoned that the earth was cold and in all their experience they had found nothing cold which possessed movement. At last driven to admit that the earth did move, these philosophers threw up their hands in despair and claimed the whole thing was a devilish arrangement at the best. "For," they said, "angels make Saturn, Jupiter, and the sun go round. If the earth does move, it must be turned from the center. Only bad angels live there and so if it does move it ought not to and no good can come of it."

This way of arriving at conclusions was characteristic of the Middle Ages. Thinkers would stay in their studies and reason things out to a satisfactory conclusion without knowing a single essential fact in the case. It was not until men got into the field and studied the problems in all their bearings that satisfactory conclusions were reached. But notwithstanding all the years of patient research in the field and in the laboratory there are still many imperfectly solved problems—more as yet untouched. A complete knowledge of any one science is impossible without a complete knowledge of all the sciences. Day by day man must change his point of view concerning new theories, discarding worn-out beliefs, looking to the light until, no longer seeing thru a glass darkly, he is face to face with the glorious dazzling light of truth.

COMMERCIAL SCIENCE

BY WILLIAM B. MARSHALL

Until within a few years colleges and universities confined themselves to classical courses. Gradually a demand arose for opportunity to study the sciences. College after college made concessions to this demand, until at the present time there is scarcely one of any standing which does not have scientific, civil engineering, electrical, mining, chemical, mechanical and other courses, each of which is considered fully as important as the classical course. Indeed, many colleges and universities owe their present fame to the sciences rather than to the classics.

Agricultural science was among the last to obtain recognition in the institutions of learning. To complete the round, agriculture and mining, representing the two principal branches of production, should be supplemented by commerce representing the transportation, manufacture, exchange and use of the materials produced. It is to the general subject of the study and teaching of commercial affairs, especially from a geographic stand-point, that I wish to direct attention.

Commerce is and ever has been as truly a science as botany or physics or mathematics. In fact it is the oldest, or one of the oldest, of the sciences, for it originated with the first exchange of value for value between man and man. It is a compound or complex science, because it involves the application of many other sciences. It is a science which every day becomes more and more intricate in its details, but which always continues to rest upon the same foundations which it has had since men first began dealing with each other.

Altho it is a science, and one of the utmost importance as touching man and all that he does, yet it is given no place in the educational institutions. It is true that we hear of commercial courses in high schools and a few higher institutions, but the commercial features of such courses mostly consist in type-writing, stenography, book-keeping, etc., and are utterly void of anything relating to the great principles upon which all commerce rests.

In the colleges political economy is the nearest approach to anything relating to commerce, but political economy is in the nature of commerce idealized. It deals with what ought to be, whereas commercial science deals with what is, including a special knowledge of the numerous exceptions to the laws as laid down in the former science.

A study of commercial science along the lines which I have in mind would investigate man and his doings, and would include a *general survey of man's use of nature and of his own powers.* It would examine the needs of man, and his methods of supplying them; his relations to his fellow men, and the relations between nations. The raw products of the world, the manufactures, the transportation and the use of materials would receive consideration. It is surprising what little knowledge men of even the highest culture have of the articles of everyday use. But few can describe the steps thru which wool passes from the time of shearing until it is turned out a piece of cloth, carpet, blanket, or other manufactured article; and very few know how felt, woolen and worsted differ from each other. At a recent exposition there was exhibited a suit of clothing which was completed in about six hours from the time the sheep were put to the sheers. The shearing, the scouring, the carbonizing, the combing, spinning, dyeing, weaving, fulling, teazling, finishing, sponging, cutting, fitting and sewing, all were accomplished in the short space of six hours. Yet but few people have any clear idea of the processes involved in taking the clothing from a sheep's back and placing it upon our own—one of the greatest of the world's industries. Few know the processes involved in the making of a hat, or a shoe, or in the preparation of breadstuffs, and yet all these articles are in everyday use by every man, woman and child.

A study of commercial science should include as a most important branch a consideration of the habits and customs of various peoples. The importance of this is illustrated by the methods of a merchant in sending out his men to drum up trade. He does not try to sell silks in the slums, nor does he try to sell hob-nail shoes in the neighborhoods of affluence; but he studies the locality and the people, and he fits his agents and his goods to suit the circumstances. So in dealing with the Chinese, for instance, we must know something of Chinese habits, tastes and methods of thinking, their reverence for the past and their wish that things might always remain as they have been for ages. Therefore if the Chinaman wishes to buy a kind of scissors that will spoil at the first clip, it would be better to sell him what he wants rather than to waste time and opportunity trying to persuade him that he would be better satisfied with another kind of scissors just as cheap and which would last a lifetime. Better let the argument follow the sale and be in anticipation of the next sale; or perhaps it would be best to leave the matter entirely to the logic of events.

Here again political economy differs from commercial science inasmuch as it makes no allowance for racial taste and prejudice, the caprice of individuals, superstition, and a host of other qualities which determine or modify transactions between man and man. From the standpoint of an American, English, French, or German political economist, the Chinaman is abnormal because he does not wish the latest type of goods. From the Chinaman's standpoint, these other nations are abnormal because they do not cling to that which met the approval of past generations. The Quaker taste or judgment calls for quiet colors; the negro likes bright colors. The Dutch like their clothing ample and their shoes heavy; the French like their clothing snug and their shoes light. The people of some nations decorate their head while the people of other nations decorate the feet.

With a sufficiently broad course of study in commercial science young men would begin their careers well equipped with a knowledge of what the people at home and abroad do and how they do it; how they live, what they eat, drink, and wear; how they hunt, fish, fight, play, and work; how they fetch and carry; how they think and act; what they produce and what they consume; how they might be made to contribute to the supplying of our needs and how they might be induced to take our products.

The institution which first introduces a course of study in commercial science which shall be entirely worthy of the name and which shall be exactly gauged to the needs of the times, will attract world-wide attention and will be an honored pioneer along the path which the others must sooner or later follow. Thus far I have spoken of the subject in connection with higher institutions of learning, believing that as soon as introduced into the colleges, universities, and normal schools, it will be systematically introduced into the elementary schools thruout the country.

In the meantime teachers in the elementary schools can make their teaching of geography more interesting and effective by striving to replace the old idea of geography — that it is a description of the earth's surface—by the better idea that it is a study of the earth as the home of man, and by the use of frequent object lessons. If the lesson relate to Mexico, try to have Mexican products, garments, utensils, flags, toys, photographs, etc., in the class-room, and point out the various ways in which the Mexican people come into contact with the people of the United States.

(To be continued with a description of the preparation and use of several object lessons.)

THE NILE COUNTRY

BY MARY E. ANDREWS

> "Now it is not thy fate to see again
> Thy friends, thy stately palace, and the land
> That saw thy birth, until thou stand once more
> Beside the river that thru Egypt flows
> From Jove, and offer hecatombs
> To the everlasting gods inhabiting
> The boundless heaven, * * * * "
>
> —*Odyssey*. (*Bryant's Translation.*)

Thus was introduced into European literature that wonderful river, the fascinating problem of whose source and overflow was only yesterday solved to the satisfaction of the modern world.

When and by whom it was first called the Nile is one of its secrets. Certain it is the ancient Egyptians never knew it by that name. They called their country *Qimit*—the black land; themselves, *Romitu*; and the mysterious stream, the source of all to them, was their god *Hafi*. They called it also *ioma*—the sea. In their strange cosmogony the great stream that ceaselessly rolled its living flood over the burning desert sands was a branch of the celestial river on which the sun boat floated. The cataract at Syene was only the last step in the tremendous descent of the waters from the realms above. Every year, Isis, weeping for Osiris, let fall a tear into the celestial stream, and immediately it swelled and overflowed, and the great river carried the flood over Qimit.

It would seem from the quotation that the Greek poet knew this ancient Nile myth; else why should he call it "the river that thru Egypt flows from Zeus?" But Homer never calls the Nile by name; and in the Pentateuch, also, we find it simply called "the river."

As the geographical knowledge of the Egyptians increased little by little, they pushed the heavenly source farther and farther south, to a great sea, where were phantom islands, serpents with human voices, dwarfs and giants, and all things strange and marvelous. The myth of the Nile source lingered among the Arabs even in the middle ages in the tradition that the mysterious stream had its source in Paradise, whence strange branches and fruits sometimes floated down to earth. And to this day, about the middle of June, the "Night of the Drop" is celebrated with great rejoicing in the city of Cairo.

We can best understand the peculiar conditions that make the river Nile possible if we look for a moment at the geological structure of its basin.

The continent of Africa, next to Asia in size, is unique among the great land masses in the manner of its formation. Other continents have grown by successive additions to nuclei formed in early Archean time. Vast accumulations of off-shore or of marsh deposits have been lifted above the ocean by foldings of the earth's crust, to be worn down, sunk beneath the water, buried under fresh deposits and again uplifted, over and over, until the present form has been attained, complex in geological structure and in related topographic features.

Not so, Africa. The whole vast interior, so far as exploration has yet revealed, seems to have been lifted bodily above the waves in remote geological time, and never again submerged. Wherever we go thruout the Nile basin, whether we cross from the Zanzibar coast and explore the equatorial lake plateau with Speke and Grant and Burton and Stanley, or wander with Schweinfurth among the cannibal tribes of Bahr-el-Ghazal; whether with Baker we turn aside from the main stream and follow the Atbara to the highlands of Abyssinia, or continue on up the White Nile to Lake Albert, the rocks are the same—granite, gneiss, schist, syenite, porphyry and their related forms—rocks that speak of the earliest formatory periods in the history of continent building. It is not until we near the borders of the continental mass that rocks of later periods are found. In the Nile basin it is not until the first cataract is reached, Lat. 24° N., Lon. 33° E., that the syenite of the primitive continent gives place to sandstone of a later age, to be overlapped at Elephantine by still more recent limestone. It is as tho the creative forces of nature, having once blocked out this huge mass and heaved it up, abandoned it to the chiseling action of rain and river, to adopt a different plan for the making of continents. And its people, too, seem equally forgotten.

This geological structure makes Africa pre-eminently the land of plateaus and of plateau carved topography, with broad, level areas lifted high above ocean, and dropping abruptly to lower levels that repeat the same characteristics. Even the mountain heights that rise above the plateau mass are generally terraced slopes, ascending step above step to summits blunt, or flat as billiard tables. The resulting drainage systems are correspondingly different from those of other continents. In other lands, as a rule, waterfalls and rapids occur high up in the river's course, or where obstruction of the ancient channel by glacial debris has caused the stream to seek a new course, as at the Falls of Niagara and of St. Anthony; and from these up-stream declivities the river pursues a gently descending course to the sea. African rivers are altogether different. Rising far in the interior, on the elevated plateau, they have long reaches of navigable waters where they traverse the gently sloping surface, and drop suddenly from one level to a lower one, forming rapids and falls well on in their journey to the sea.

If we draw a line from a point on the Red Sea coast crossed by the parallel of 15° N. Lat. to a point on the Atlantic coast crossed by the parallel of 15° S., we shall follow in a general way the most important line of descent from the elevated southeastern mass of the continent to the less elevated northwestern part. Passing the lofty Abyssinian highland, we find the lower interior plateau margin all along this line carved into picturesque heights, which Schweinfurth calls the Galla Abyssinian Highlands, or the Terrace Chain. The line crosses the Nile at Lado, Lat. 5° N., Lon. 31° 30′ E., where the river, after breaking thru the Latook Mountain barrier, leaves the highland interior to wander in interminable swamps over the lower level, on its way to Khartum.

From this great plateau three narrow tongues of highland extend to the northwest. One, along the western coast, does not interest us at present. The second, extending northwest from the region of Lake Albert, lower in level than the main plateau mass, curves around to the northeast in Dār Fur. It forms the rim of Bahr-el-Ghazal basin and the water parting between Nile and Congo on the southwest and Nile and Lake Tchad on the northwest. The third, a spur of the Abyssinian uplift, tho much lower in elevation than the second, extends north between the Nile and the Red Sea, sending the torrents that fall at rare intervals down either slope to these waters. This Nubian line of heights, together with the low

Libyan range on the opposite side of the Nile, close in upon it, changing the river basin to a simple valley—forming a narrow conduit by which the basin communicates with the Mediterranean.

The great gneiss plateau on which the Nile has its source gives evidence of past volcanic activity in the occurrence of lava in many places, sometimes forming vast sheets comparable to the Jurassic lava floods of Oregon and Nevada. And finally, by some stupendous disturbance, or series of earth movements, it has been rent from north-east to south-west for thousands of miles, forming the Great Rift Valley. This singular depression, first traced by Suess from data furnished by explorers, consists of a double line of fissures between which the land has sunk, forming a double line of faults, and giving rise to vast chasms and gorges. It begins in northern Palestine, where the river Jordan and the Dead Sea occupy one of its profoundest depths. Continuing thence by Wady Arabah to the Red Sea trough, it is there entered by the waters of the ocean. Crossing the African continent from the southern end of the Red Sea, at Lake Rudolph, Lat. 3° N., Lon. 36° E., it splits into two branches, one south-east, not far west of the mountain chain over which Mt. Kenia presides, and the other south-west, which crosses the Nile near the entrance of Lake Albert. In this western branch lie Lakes Albert and Albert Edward of the Nile system, Lake Tanganyika, which in high water drains thru a rift in the western wall into a tributary of the Congo, and farther on, Lake Nyassa, which sends its waters southward to join the great Zambezi.

Between these two branches of the Great Rift valley stands the Uganda plateau, 5,000 feet above the sea; and sunk below the level of the plateau lies the basin of Victoria Nyanza, queen of all highland lakes the world around.* With an area as great as that of Scotland, it lies under the perpendicular rays of the equinoxial sun, but lifted almost a mile into the cooler regions of the atmosphere.

Lakes Victoria and Albert, the one spread out on the broad gneiss plateau, the other confined between the precipitous walls of the Great Rift valley, 1400 feet below, are typical of the two classes of lakes found in equatorial Africa: the one expansive in outline, with shores sometimes rising in bold headlands, it is true, yet for the most part low; the other long and narrow, fiord-like in scenery, skirted by precipitous heights, rising more than a thousand feet sheer above the water into which the splintered crags jut boldly out. Victoria Nyanza is a plateau lake; Albert Nyanza, a Rift Valley lake, whose characteristic features are shown again in Albert Edward Nyanza, Tanganyika, and Nyassa.

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*Lake Superior has a greater area, but it can scarcely be called a highland lake since it is but 602 feet above the sea.

The discovery of these two equatorial lakes, the Victoria by Speke in 1858, the Albert by Baker in 1863, gave the final answer to the question so earnestly asked more than twenty-three centuries ago by Herodotus, the first great European traveler who wrote of the Nile.

"With regard to the *sources* of the Nile," he wrote, "I have found no one among all those with whom I have conversed, whether Egyptians, Libyans or Greeks, who professed to have any knowledge, except a single person. He was the scribe who kept the register of the sacred treasures of Minerva in the city of Sais, and he did not seem to me to be in earnest when he said that he knew them perfectly well. His story was as follows: 'Between Syene, a city of the Thebais, and Elephantine, there are,' (he said.) 'two hills with sharp, conical tops; the name of one is Cophi, of the other Mophi. Midway between them are the fountains of the Nile, fountains which it is impossible to fathom, * * *.' "*

As far back as 100 B. C., however, Hipparchus sketched a map in which he makes the Nile rise in three distinct lakes. Ptolemy, in 150 A. D., repeats the three lakes, placing the two remoter ones to the south of the equator, east and west of each other. Edrisi, an Arabian geographer of the twelfth century, also shows the three lakes, placing the more distant ones side by side, to the northward of a range of mountains called the Gebel Kumr—Mountains of the Moon. Later reports of Arab and of Portuguese traders all testified to the presence of great lakes and lofty mountains in the interior of Africa, and the maps of Verrazano and Sebastian Cabot repeat these features. Yet during the seventeenth and eighteenth centuries the lakes disappeared wholly from the maps and the minds of the European world; and tho "Montes Lunae" lingered thru part of the nineteenth century, they, too, disappeared at last. It required the painful toil and heroic endeavor of such men as Speke and Grant, Baker and Stanley to convince the savants of the nineteenth century that the ancient geographers were right in the main features of their maps.

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* Rawlinson's Herodotus.

How much of the great gneiss plateau that lies between the eastern and western branches of the Rift valley is within the basin of the Nile is not yet fully determined. The country to the south and east of the great Nyanza has been less explored than that to the west and north; but the absence of important tributaries to the Victoria, together with the reports of natives, point to the presence of enclosed basins which receive part of the drainage of the country to the eastward of the great lake.

From the southernmost point of the Victoria Nyanza eastward around to Ripon Falls, where it discharges its waters into the Victoria Nile, the Shimiyu is the only important tributary entering the great Nyanza. The cool springs and copious streams which form the headwaters of this river, among the southern highlands 5,400 feet above the sea and about 5° S. Lat., probably form the remotest source of the Nile waters. They are in a rich upland region, which soon passes into a beautiful pastoral country that stretches to the border of Victoria Lake. Grains, potatoes, beans and other upland products are raised in abundance by the natives. Large herds of cattle browse over the rich grassy plains, and cranes, herons and other water-loving birds follow the sparkling streams. Stanley speaks of weird gray rock piles rising here and there, of granite ridges, and low, detached hills, from the summit of which beautiful views may be had of the surrounding country.

The broad plateau that can cradle a lake in which all Scotland might be sunk, offers room for many diverse people; and the native tribes of central Africa differ as widely as do the various nationalities of Europe or of Asia. From time immemorial Africa has been subject to invasion. The level upland that stretches from Somali Land to the southwestward offers little obstruction to the invader; and tribe after tribe has passed over from Asia, penetrating far into the interior. The blending of Asiatic with African types has given rise to many variations from the original. The one distinctively African feature which seems to be retained by all is the kinky hair of the typical Negro; but in complexion many shades are met with, from coal black and dusky brown, to a color differing little from that of dark-complexioned Europeans. Wherever Asiatic blood has intermingled with African, the natives show a decided superiority over their purely African countrymen, even tho the savage nature may have lost nothing in fierceness.

Stanley's famous cruise in the "Lady Alice" a quarter of a century ago (March 8 to May 6, 1875), when he circumnavigated the lake in order to decide the question, so hotly disputed, as to whether the Victoria was one lake or five, gave him a panoramic view of the country and inhabitants bordering the great fresh-water sea. He found the population of the lake shore varying greatly as to temper. There were the Wavuma, fine, manly, well-made fellows, but treacherous and fierce, riding the waters in beautiful canoes only to plunder with insolent bravado; the more peacefully disposed inhabitants of Namungi Island, who exchanged bananas, fowls, eggs and sweet maramba, or banana wine, for beads, so dear to the heart of the African savage; the natives of Maheta coast, who came to the shore and launched their spears the instant the explorers prepared to land; and farther on a boat-load of savages tipsy with pombo, the fermented drink of Central Africa. At Bumbireh island the brute fury of the savage reached its height. There scores of all but naked demons rushed upon the explorers, shouting the war cry of Central Africa, "He-hu-a-he-hu-u-u-u!" and attacked them with the savage fury of wild animals.

The many uninhabited islands in the lake were a welcome refuge from the human beasts that swarmed along the shore, but even there the huge hippopotamus, lord of the Nile waters, sometimes successfully disputed the right of way, while on others crocodiles were lords of creation, with multitudes of lesser creatures for subjects—monitors, lizards, skinks, geckoes, with insects of innumerable varieties, from the ever-present white ant to the gorgeous butterfly of the tropics.

The one redeeming spot in all this wilderness where brute force reigned supreme was the country of Uganda, lying between the Victoria Nile and the Magunga. In this rich pastoral country bordering the great inland sea, Speke, who first of all white men visited it in 1862, found a people far advanced towards civilization. Living in neat grass huts, completely clothed in garments of spotless cleanliness, brave in war yet practicing the arts of peace, the Waganda of half a century ago were vastly superior to the average African savage; and the Waganda of to-day, under the fostering care of Christian missionaries, with its 372 churches, its cathedral seating 3,000 worshipers, its native missionaries sent to all the region roundabout, its workshops where native youths are taught useful occupations, is an ever brightening spot in the heart of darkest Africa.

The ruler of Uganda when Speke, and afterwards Stanley, visited it, was Mtesa, whom Stanley calls the most interesting figure in central Africa. His admiration for the white man was in sharp contrast with the brute hostility shown almost universally elsewhere. He was a man of keen intelligence and a powerful ruler. He never tired of listening to "Stanlee" and of asking him questions, and it was his urgent request that English missionaries should be sent to the Waganda.

(To be continued.)

PHYSIOGRAPHY OF WISCONSIN

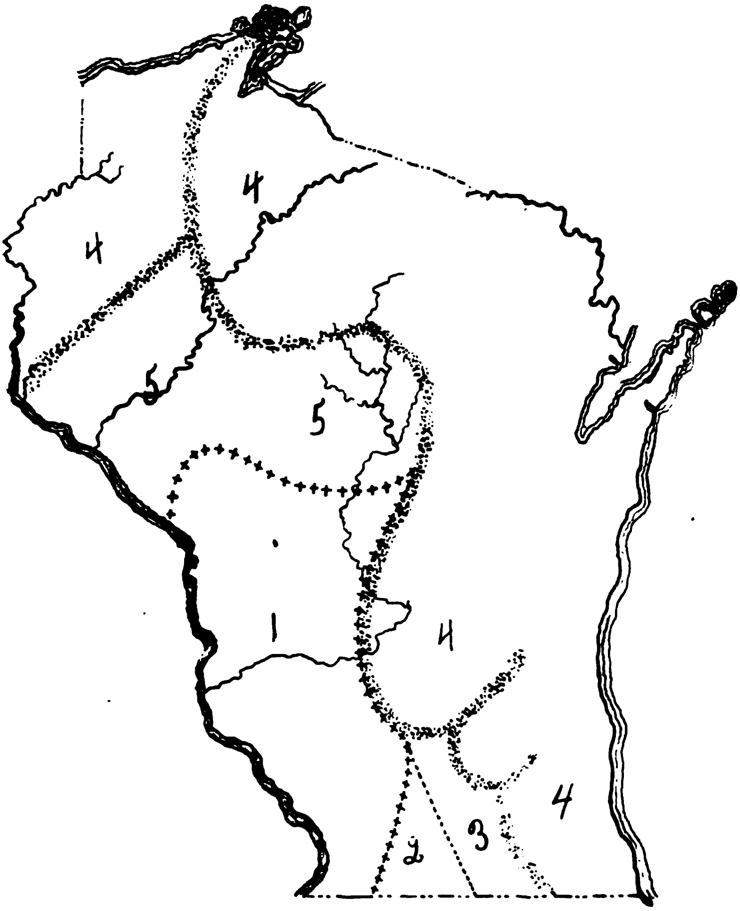
BY GEORGE L. COLLIE

- Introduction
- The Lake Superior slope
- The Wisconsin slope
  - Divisions of the Wisconsin slope
    - The Driftless area
    - The Drift area
      - The outer drift province
      - The middle drift province
      - The inner drift province
        - The morainal region
        - The lacustrine region
- Summary

INTRODUCTION

Wisconsin is a part of the Lake Plains system of the northern United States. Like other portions of this system, it possesses an undulating topography with comparatively little relief. As a whole, Wisconsin is a poorly drained region; its area is covered with numerous lakes, marshes, and small lacustrine plains. The average elevation of the state is 1050 feet above sea level; it is the third in order of elevation among the states east of the Mississippi river.

The state may be divided into two major slopes—one to the north, the other to the south. These two slopes meet in a series of ridges, which lie within a few miles of Lake Superior. This arrange-



SKETCH MAP OF WISCONSIN (Showing the different provinces)

+++ Boundary of Driftless Area
·:·:·:· Boundary of Inner Drift Province (Terminal moraine of Wisconsin epoch)
1. Driftless Area
2. Outer Drift Province
3. Middle Drift Province
4. Inner Drift Province
5. Undifferentiated drift belonging to outer and middle provinces

ment results in one slope being long and gentle, while the other is short and steep.

Each of the two unsymmetrical slopes has its own peculiar topography, which will be described later in this paper. There are certain features which both possess in common, which may be mentioned at this point. The ridges, in which the two slopes meet, are composed chiefly of much folded and tilted igneous and metamorphic rocks. On the other hand, the rocks which underlie the two slopes are sedimentary rocks, sandstones, limestones, and shales. In addition to their sedimentary character, the rocks under each slope are not disturbed in a noticeable way. Unlike the rocks of the ridges, they are not folded or tilted, but lie horizontally or nearly so. Again the two slopes are alike in possessing a thick mantle of glacial drift, which greatly modifies the original topography of each slope. The arrangement of drift is much the same on each of the two slopes, so that they bear a superficial resemblance to each other.

After this general statement respecting the topography of the state, consideration will now be given to the two slopes already mentioned.

THE LAKE SUPERIOR SLOPE

This slope is the smaller and steeper of the two portions into which the state is divided. It begins at the foot of the Douglas and Penokee ranges and extends to the shore of Lake Superior. It is a comparatively narrow plain, not exceeding fifteen miles in average width. Where the slope joins the ranges, there is, frequently, an abrupt declivity.

This cliff is particularly noticeable, because it is not formed, as most of the Wisconsin cliffs are, by erosion. It is a fault cliff, formed by the movement of rocks one upon the other; the cliff is a marked feature of the landscape, especially when viewed from the lake shore.

On the lake side, the plain ends abruptly in cliffs, which rarely exceed a height of fifty feet. In many instances these lake shore cliffs are composed of sandstone; more often the material is glacial drift, for the latter has been deposited in great quantities on the sandstone, and buried it out of sight. Portions of the plain have been cut off from the mainland and now exist as islands. There are a number of these islands; some of them cover an area of several square miles.

Wave action has worn the sandstone cliffs, both on the mainland and on the islands; as a result numerous caverns have been formed, also the long, narrow, cañon-like chasms, called coves. The cliff faces are often of great interest, on account of the fantastic architecture exhibited by them.

The streams that cross the slope are usually small; most of them rise on the flanks of the range and flow into the lake, a distance of fifteen or twenty miles. The streams meander after reaching the foot of the ranges. They also cut deep cañon-like valleys, with very few branches. These valleys are the only important topographic feature on the slope, aside from a few moraines. In most cases the glacial debris has been sorted by water; it is, there fore, arranged in shoots, as a rule. It does not take a prominent part in the making of the topography.

THE WISCONSIN SLOPE

This slope is a broad and somewhat diversified plain which slopes away from the ranges already mentioned. The highest portion of the plain is that adjoining the ranges; the lowest portion is that adjoining Lake Michigan in the southern part of the state. The slopes are arranged radially from the highlands; the streams follow these diverging slopes, flowing to the southwest, south, and southeast.

The Wisconsin slope covers an area of fifty thousand square miles; its topography is quite simple, speaking in general terms. There are many detailed features of interest, but the limits of this article do not permit of their portrayal. Many of the more striking features are due to river erosion, as is naturally the case in regions made up of plains. The most marked single feature of topography in the state is the escarpment. There are two especially prominent escarpments, namely, the Military Ridge escarpment and the Winnebago escarpment. The first originates near Madison and extends to the Mississippi river. It lies parallel to the Wisconsin river, to whose erosive action it is due.

The ridge averages 1200 feet above sea level and is a conspicuous feature, with its great mural front rising above the general level of the Wisconsin valley. The escarpment has retreated some distance from the river and now lies fifteen miles away, on the average.

The Winnebago escarpment is even more conspicuous than the Military Ridge escarpment. It begins on Door peninsula, between

LOOKING DOWN THE MISSISSIPPI RIVER FROM THE BLUFFS AT ALMA, WISCONSIN.

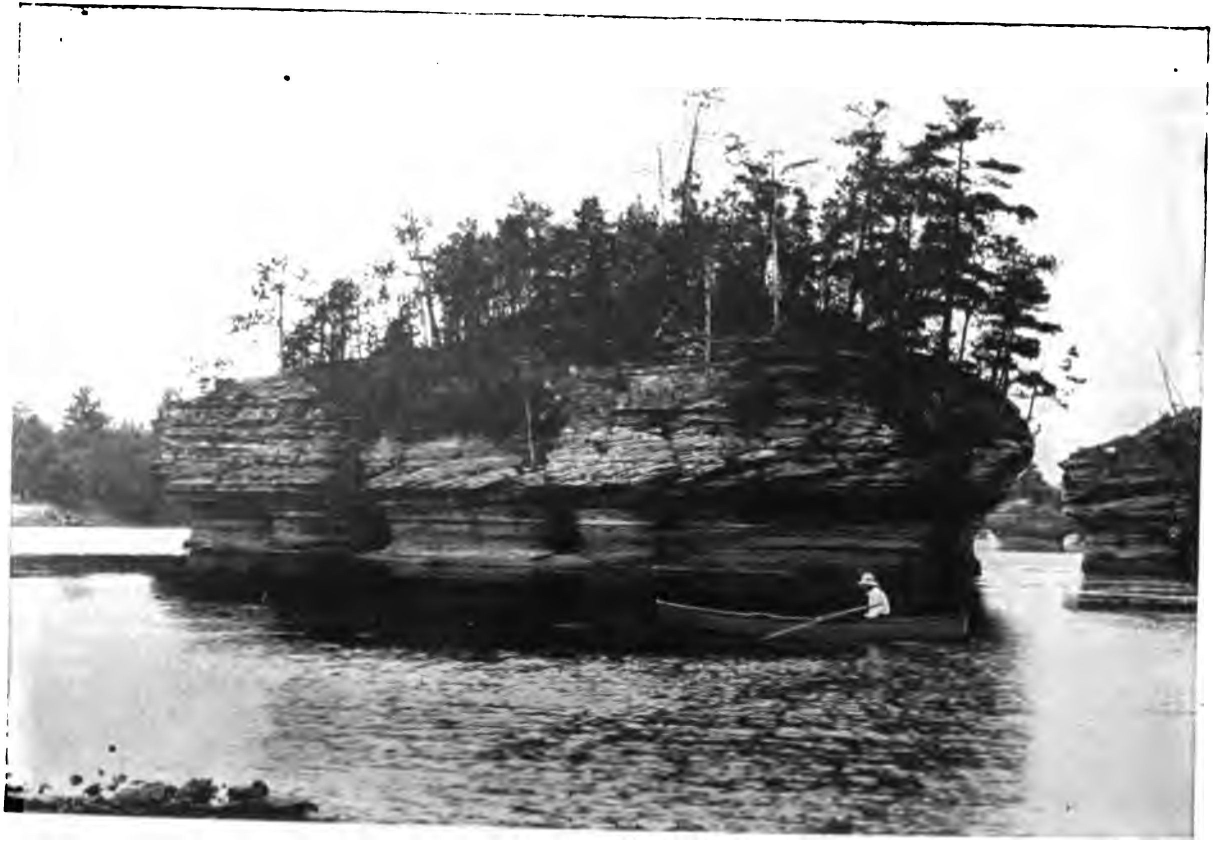
"The eye sweeps the horizon for miles, meeting only an even sky-line."

Green bay and Lake Michigan; it extends in a southwesterly course until Lake Winnebago is reached, whence it trends to the south. It is still a prominent feature of the landscape on the east shore of the lake, opposite Fond du Lac. The ridge gradually dies out as it proceeds southward and finally is lost in the morainal accumulations in the southern part of the state. Each of the escarpments is due to the fact that a soft rock underlies the hard surface limestones. The soft rock is undermined by erosive agencies, causing the hard rocks to break off, thus forming steep cliffs. The escarpments keep retreating in the direction of the dip of the rocks. In the case of Military ridge this retreat is to the south; in the case of the Winnebago escarpment the retreat is to the east.

DIVISIONS OF THE WISCONSIN SLOPE

Six-sevenths of the Wisconsin slope is covered by glacial debris of various types. One-seventh of the slope contains no glacial material; it is an unglaciated region and is known as the driftless area. It is possible therefore to divide the slope into two areas of unequal size, on the basis of the presence or absence of the glaciation. Each of these portions will now be described beginning with the unglaciated area.

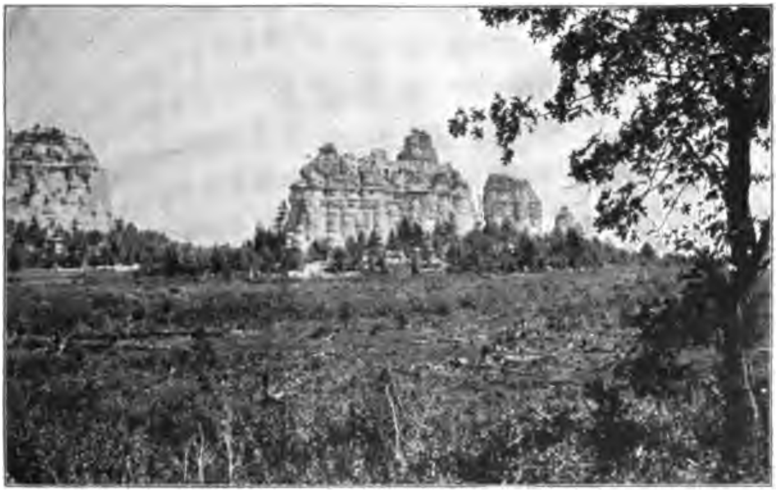
The Driftless Area.—Tho the driftless area is comparatively small, it is of great significance to the physiographer, because in this area is represented in utmost detail the topography and the drainage features that prevailed over much of the state in preglacial time. A brief description of this region is due, not only for its own sake, but because it gives a correct idea of the general appearance of preglacial Wisconsin. The first and most notable characteristic of the region is the peneplain character of the upland surface. If a person stands on any portion of this upland, the eye sweeps the horizon for miles, meeting only an even sky-line. It is possible to look across the country to the horizon in every direction; there are no prominences to cut off the view, as is the case in the drift area. Only an occasional butte or monadnock rises above the general level of this driftless area. A second feature of the region is the presence of deeply incised river valleys. These streams have cut deep valleys 150 to 200 feet below the surface of the smooth uplands. The sides of the valley are usually steep bluffs, making an abrupt transition from the uplands to the valleys. A third feature is the mature development of the streams.



IN THE DALLES OF THE WISCONSIN.

"A picturesque, postglacial gorge near Kilbourn City, Wisconsin."

The head waters of one stream interosculate with the headwaters of other streams; every field in the region is well drained. The inter-stream spaces are frequently nothing more than narrow, winding ridges, scarcely wide enough for the roadway or the railway, which seeks to utilize these natural roadbeds. The maturity of the drainage is shown not only by the complete development of the drainage, but also by the character of the streams; they are meandering types, which are approaching their local base level. These streams swing from one side of their flood plain to the other; they are engaged in widening their channels rather than in deepening them. The work of planation by the streams has gone on to such an extent that the region as a whole may be regarded as a typical example of a country once peneplained and now well advanced toward a second peneplanation.



CASTLE ROCKS, CAMP DOUGLAS, WIS.

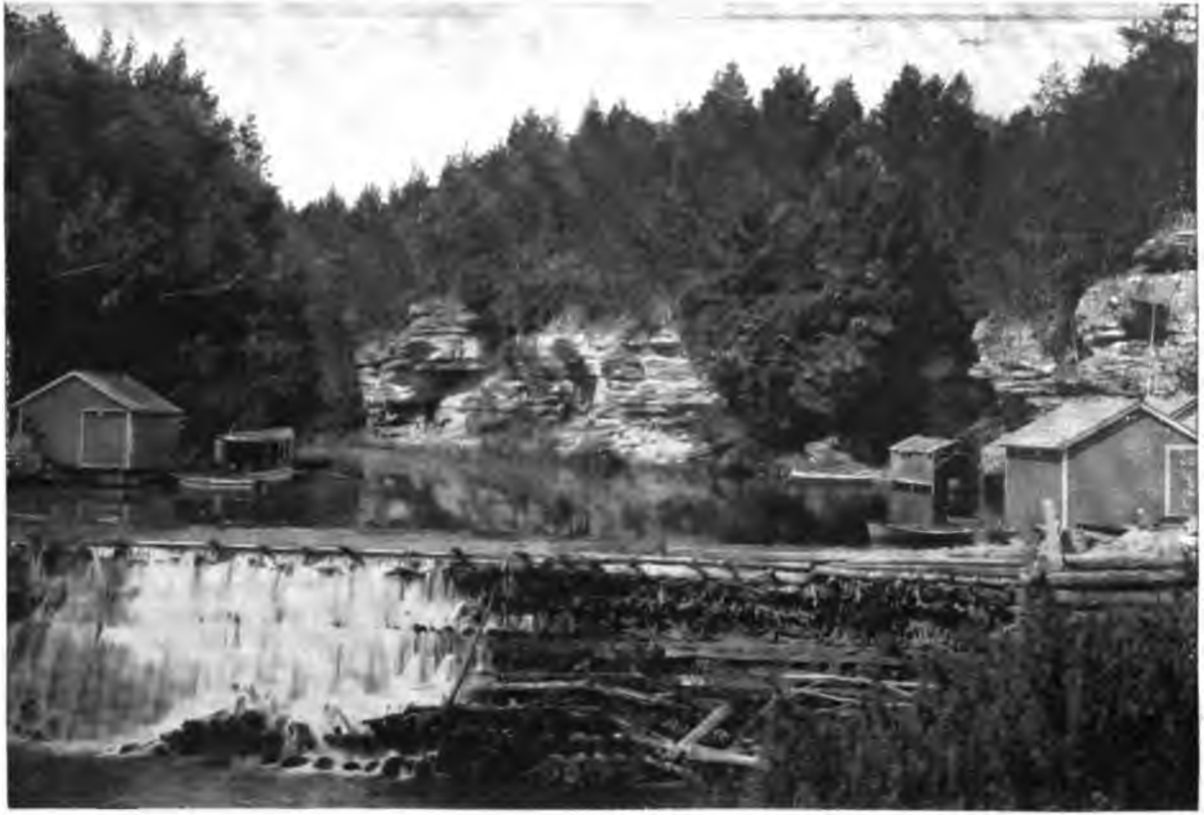
"A fourth feature of the driftless area is the presence of uneroded remnants or monadnocks. Where sandstone is the prevailing rock, these remnants are castle-like buttes or even slender columns."

A fourth feature of the region is the presence of uneroded remnants or monadnocks. The larger of these remnants are locally termed "Mounds." The largest of the mounds are the Blue mounds, twenty-five miles west of Madison. The Blue mounds are in reality one monadnock with two summits. They cover an approximate area of five square miles, the summit of West Blue mound is 1,729 feet above sea level. This monadnock is one of the most conspicuous features of its kind in the Mississippi valley. The dome-like mounds are confined to the southern part of the driftless area, where limestone is the surface rock. In the northern portion of the area, where sandstone is the prevailing rock, the remnants have a different form. The sandstone is more readily eroded, and it is capable of taking on more diverse architectural effects than the limestone. In this northern part of the area, therefore, the remnants are not mound-like forms, but they are castle-like buttes or even slender columns. These latter types are found especially in Juneau county.

These monadnocks and buttes tell an impressive story of erosion and degradation. All of the intervening spaces between the solitary remnants were once filled with limestone or sandstone: nothing remains but a few straggling masses. When one thinks of the area covered by this wholesale erosion, the story is all the more impressive; it is more striking than that told by such a gorge as the Grand Cañon of the Colorado. Many people call the driftless area the "Switzerland of Wisconsin," expressing in this rather forcible way their sense of its rugged and picturesque scenery. A fifth feature of the region is the total absence of lakes and extensive marshes, such as characterize other portions of the state.

The Drift Area.—The drift area is characterized by the presence of topography which has been formed chiefly by glacial action. There are numerous aggregations of clay and gravel not found in unglaciated regions. In a general way there is no such complete drainage as that found in the driftless area. There are very few broad, deep valleys.

There is no even upland surface; instead there are numerous hummocky hills and elongated ridges. Partly from a topographic standpoint, partly from a geological standpoint it is possible to divide the drift area into a number of provinces, based on the age of the drift found on the surface. A number of successive ice sheets passed over Wisconsin; and at least three of these ice sheets left deposits to indicate their presence. It so happens that these deposits are arranged like shingles, each of the older deposits appearing from beneath the next younger deposit. It is proposed to name these provinces from their relative position and to call them the outer, middle, and inner drift provinces. In all probability



ONE OF THE MANY GORGES TRIBUTARY TO THE WISCONSIN RIVER NEAR KILBOURN CITY.

these three provinces correspond respectively to what are known as the Illinoian, Iowan, and Wisconsin drift sheets. The division of the drift into outer and middle provinces is possible only in the southern part of the state. The writer has had no opportunity of studying the older drift north of the driftless area. Unquestionably careful study would reveal provinces in that region also.

The Outer Drift Province.— This province is roughly triangular in form. It is widest at the state line and tapers gradually until it disappears beneath the Wisconsin drift near the southern boundary of Dane county.

The base of this triangular province is about thirty miles wide and lies between the Pecatonica and Sugar rivers. The total area of the province is about 400 square miles in southern Wisconsin.

The topography of this province combines the features of both the driftless and drift areas. The drift is spread out in the form of

SOUTH END OF DEVIL'S LAKE, WIS.

"Masses of drift serve as dams in the preglacial river gorge."

a sheet: this sheet is not continuous, but occurs here and there in patches. The drift is not very thick, as a rule. For this reason the pre-existing topography is not greatly altered by the presence of the drift. The valleys are filled to some extent by the drift, while the upland surface frequently contains little or no drift. This

STAR LAKE. IN THE LAKE COUNTRY OF NORTHERN WISCONSIN.

fact tends to cause less relief than is found in the driftless area. There are occasional knolls and ridges of drift; they generally lack the definiteness of such accumulations in the later drift deposits, and merge gradually into the surrounding plain. There are few abrupt transitions, such as one sees in the morainal accumulations of the Wisconsin epoch. There are no such continuous ridges; there are no true eskers, kames, kettles, or drumlins, such as are seen in the later glacial accumulations. These occasional knolls of drift have some effect upon the topography, but they are not numerous enough to have a very marked influence. The drainage is quite mature in this province; the rivers do not seem to be diverted from their original courses. There are no lakes and very slight evidence of lacustrine plains.

The Middle Drift Province.—This province is confined almost wholly to Rock county. It is quadrilateral in form and covers an approximate area of 800 square miles. The drift is thicker than in the outer province, but it is not so thick as to wholly obliterate the preglacial topography. Preglacial valleys, notably that of the Rock, are a feature of the topography. Masses of rock, belonging to preglacial topography, rise thru the drift in many localities. The drift topography is much more evident than in the outer province, and there are a great many more glacial hills. They have stronger relief and a correspondingly greater effect upon the topography. Well developed morainal ridges occur; the moraine, which the author calls the Beloit moraine, is an example. This ridge extends from the west bank of the Rock at Beloit with few interruptions to the neighborhood of Evansville, where it is buried beneath the wash from the Wisconsin moraines. Associated with the Beloit moraine at several points, especially in the neighborhood of Footville, there are gravel hills, known to geologists as kames.

Within the Beloit moraine, a few miles to the east, are found a series of smooth oval hills, known to geologists as drumlins. Drumlins are common in the inner drift province, but are very rare in the middle province. The drumlins of the middle province are located chiefly about the town of Clinton. In this particular locality the hills are low and of small size, retaining, however, the characteristic drumlin outlines. The longer axis of a drumlin is parallel to the direction of ice motion, and the arrangement of the drumlin axes in this region shows that the ice moved west.

Rock river flows thru the midst of the middle drift province.

It is an ancient stream, which had eroded a wide and deep channel before the coming of the Pleistocene glaciers. This channel became the runway for waters coming from the melting glaciers, this being especially true during the melting of the Wisconsin glaciers. Vast quantities of sand and gravel were carried down Rock river valley at the close of the Pleistocene by the swollen streams of that time. North of Janesville this material accumulated to such an extent that the river was forced to abandon its old channel and seek a new one. At Janesville the Rock returns to its old channel, tho it is filled to a large extent with debris of glacial origin. This gravel-filled valley is a striking topographic feature —the most striking individual feature in the province. It is a great, flat, fluviatile plain, composed of sand and gravel, which extends from the inner drift province to the Illinois-Wisconsin line and beyond. This valley train is between three and four miles wide—its length in Wisconsin being twenty miles. This flat expanse of gravel is trenched by streams; and wherever this has happened a well defined terrace exists. At Beloit the terrace is thirty feet above the river. It should be remembered that tho this gravel train crosses the Iowan, it is really of Wisconsin age. Lakes do not occur in this province, but lacustrine plains and abandoned shore lines are found.

The Inner Drift Province.—The Wisconsin ice sheet was the most active of the series and left behind it the greatest amount of glacial material. This debris, in most localities in Wisconsin, is so abundant that it buries all the preglacial topography so deeply that it has little influence on the present topography. It is so abundant that the preglacial stream-courses are filled, and as a consequence every stream is flowing in new channels, made in postglacial times. Innumerable lakes and marshes abound, being the most characteristic feature of the topography in most portions of the area under consideration. The glacial hills made by the Wisconsin ice sheet are much more prominent than is the case with the earlier ice sheets. In a majority of instances, much of the present relief in eastern and northern Wisconsin is due primarily to glacial action. Most of the area under consideration is characterized by the presence of prominent ridges and knolls called moraines.

Adjoining Lake Michigan there is a narrow strip, which has evidently been covered with water in recent time. The topography is flat and without much relief. It is best to make a division of the inner drift province into two subprovinces, the morainal subprovince and the lacustrine plain subprovince.

The morainal subprovince.—This subprovince includes about three-fourths of the area of the state. Its chief characteristic is the presence of numerous moraines, which are arranged in a series of loops. The reason for this looped arrangement is that the ice did not advance with an unbroken front, but came in a series of lobes. In all probability these lobes did not advance simultaneously, but some culminated before the others. The ice lobes have received names, such as the Superior lobe, Chippewa lobe, Green Bay lobe, and Michigan lobe. The Michigan lobe sent off a minor lobe, which the author calls the Geneva lobe. This latter lobe, tho small, made some of the most characteristic topography in the state. It was about thirty miles wide.

The topography of the interlobate moraine differs from that of other portions of the terminal moraine. The interlobate moraine is characterized by long ridges that run parallel to the general direction of the ice motion. They are frequently called "Hogbacks" by people in the region in which they occur. Washed deposits of gravel and sand in ridges similar to eskers are also frequent in the interlobate moraines. Other portions of the terminal moraine are characterized by a hummocky topography. in which

IN THE UPPER NARROWS OF THE BARABOO RIVER. A PREGLACIAL GORGE.

the round hills known as kames are very abundant. Within the terminal moraine there are numerous other moraines like the outer one, except that they are not so well developed, as a rule. Usually these inner moraines, or moraines of recession as they are called, are concentric with the the outer moraine. This is not always true, especially among the moraines of the later portion of the Wisconsin epoch. Immediately in front of the terminal moraine of the Wisconsin epoch, the topography is usually quite flat, forming what are called prairies. In many cases these prairies are lacustrine plains, which were formed when lakes stood in front of the ice. In many cases they are, in part at least, due to wash from the moraine, which accumulated in great beds. A fine example of this type of plain is seen near the junction of the Green Bay and Geneva lobes, in the western portion of Walworth county. Here vast quantities of gravel and sand were washed from both ice lobes into a common channel, from whence it spread out into a great gravel plain. This plain is at the head of the Rock river gravel plain.

Another marked feature of the inner drift topography is the presence of numerous hills, known as drumlins. These are smooth hills of till with axes in the direction of the ice flow. The drumlins are mainly confined to the region covered by the Green Bay ice lobe. They are most abundant in the region between Madison and Watertown. They occur by thousands in Dane and Jefferson counties. If this region be studied as a whole, it will be seen that the drumlins do not all lie parallel to each other, but that they exhibit a radial arrangement of their chief axes. This is due to the fact that the Green Bay ice lobe had an axio-radiant flow, which in turn caused the drumlins to lie in their present position.

Few of the glacial hills known as eskers have been observed in Wisconsin, tho a few are found, especially in drainage ways.

The most characteristic surface feature in the glaciated region of Wisconsin are the lakes and swamps and lacustrine plains. The distribution of the terminal moraines can be premised by the occurrence of lakes and swamps. As has been noted the outer drift province contains no lakes or lake beds; the middle drift province contains no lakes, but lake beds are distinguishable. In the inner drift province, lakes are abundant, tho many of them have disappeared in whole or in part. Most of the lakes occur in close connection with moraines. Usually these are small, tho a number of these kettle lakes may coalesce and form a good sized, but very irregular, lake. Some of the larger lakes like Winnebago, Green, and Geneva, are not true morainal lakes, but occur in preglacial valleys, which have been partially clogged up by glacial debris. These lakes tend to be long, narrow and deep; the underlying rocks may crop out on the banks of the lake forming cliffs. In some cases the lake has receded from its former extent, leaving wide, lacustrine plains to show the former extent; this feature is well shown on the west side of Lake Winnebago. The smaller lakes of the state are in all stages of deterioration. There is no lake which does not show evidence of retreat, but the rate of disappearance varies in different cases. In many instances, the lake has wholly disappeared, leaving only an extensive swamp, as the Horicon marsh for example. In other instances there has been but slight withdrawal, as in the case of Lake Geneva. Most of the lakes are filled with aquatic vegetation, which portends the speedy extinction of the lake.

ALONG THE BARABOO RIVER, WISCONSIN.

The lacustrine plain area.—This area is a narrow strip that borders the shore of Lake Michigan. It has been traversed by glaciers as the remainder of the region has been, but its topography is different than the drift region, because it was subsequently covered by the waters of the lake. This took place during the retreat of the glacier. As the ice retreated, a lake was formed in the basin of the present Lake Michigan. This beginning lake is known to geologists as Lake Chicago. Several stages of lake history succeeded this stage, in some of them the lake being much greater in areal extent than now, and flooding the present banks for a few miles to the west. In some of these expanded stages the lake stood long enough to make well defined beaches and other shore marks. Sufficient debris was carried in and distributed to form a lacustrine plain.

This area, tho somewhat elevated above the lake, possesses a flat, prairie-like expanse with but little relief, and is often poorly drained. There are no marked features about it. The most interesting characteristic is the presence, occasionally of lake terraces or beaches. The streams that cross this area are for the most part sluggish rivers that have cut down close to the lake level, forming in some instances deeply incised trenches. They sometimes show a tendency to flow parallel to the lake for some distance, before they finally succeed in breaking thru the shifting bars; this is notably the case with Pike river.

SUMMARY

Wisconsin is a part of the Lake plain system of the northwest. It is divisible into two slopes, one sloping toward Lake Superior, the other toward the south. The latter slope may be divided into divisions on the basis of the presence or absence of glaciation. The unglaciated portion is called the driftless area, and covers about 10,000 square miles in Wisconsin. It is characterized by the total absence of glacial material; also by the absence of disarranged drainage. The region has a flat upland surface, in which deeply intrenched streams meander. The drift area is divisible into a number of subdivisions based upon the age of the drift.

The oldest of these is the outer drift province, which is characterized by feeble development of glacial topography. There are no lakes and no clearly defined lacustrine plains. The next oldest deposit is the middle drift, which has better developed glacial topography than the first, and distinct moraines and drumlins occur. Old lake basins are still visible, tho no lakes are found. The youngest of the provinces is the inner drift province. Glacial topography is well developed in this area, especially moraines and drumlins. The eastern portion of this area has been covered by the waters of the lake, and this has caused a lacustrine plain topography along a narrow strip of the lake shore.

EDITORIALS AND NOTES

The Geographical Cabinet

An important part of the work of the teacher of geography is to acquaint his pupils with the leading facts pertaining to the relation between the activities of man and his geographic environment. Think of the scope of the subject, of the limited range of observational study, and then of our equipment for carrying on the work. To accomplish the desired result the average teacher still depends largely upon words.

There should be a greater effort made to bring the actual conditions of the real but unseen outer world before the children. One means of bringing about this result is thru the use of the geographical cabinet. This should be a part of the equipment of every school, and as far as possible the children should furnish the materials. From the industrial standpoint these materials will consist of raw and manufactured products of world-wide importance, in their various stages or conditions; pictures illustrating those not to be obtained, as well as pictures of the industries which these commodities give rise to. With maps before them, the pupils can trace the distribution of a given product, the necessary conditions as to soil and climate,—if it be a vegetable product,—the manner of cultivation and preparation for market, and the lines by which it is exported. This illustrative material forms the most rational and interesting basis for the study of industrial conditions.

The cabinet should also contain pictures of people of other lands, pictures of their homes, articles of dress, toys, coins, pictures illustrating means of conveyance, etc. These will give force and value to the study of political and social conditions.

A point of vital importance is that the pupils should be encouraged to obtain the materials themselves. They will draw upon store, mill, factory, forest, farm, and mine. They will enlist the aid of parents and friends; they will secure much valuable material in the form of loans. Using the cabinet as a starting point, intensely interesting work can be done in comparative geography.

From this line of work it is easy to develop the thought that there must be a division of labor; that all must be engaged in some line of work, and that all forms of honest labor are ennobling. The pupils will discover that nations and individuals are dependent upon one another, and that different geographic conditions naturally result in different social conditions. This will create sympathy and respect for people in all walks of life and in all countries, and will lay a foundation for that broad patriotism which recognizes the whole world as one's country and all mankind as one's kin. J. F. C.

Illustrative Material on Race Life One feature of primary geography to be emphasized in the future is the child life of typical races of the world, especially those which illustrate the control exercised by climate and the strongest physiographic surroundings, and those which embody the characteristics of different periods of race development. Since the days of Jane Andrews, sketches and stories adapted to children have multiplied for this purpose, and there are many valuable books for the teacher, such as Little Folk of Many Lands. There is still room for the provision of better pictures to illustrate such sketches, but the greatest need is for objects and models illustrative of other modes of life than our own. Some of my primary assistants gather in from the homes of their city pupils curios from Japan or China, and Eskimo or Indian implements, for use in such lessons; but this material cannot be depended on, and seldom includes the plain implements and utensils of every-day life. There is needed in every system of schools sets of specimens to illustrate the life of a dozen typical races. These should include a model of a house, and models or specimens of enough tools, articles of wearing apparel, etc., to give a clear basis, in connection with related photographs and stories, for the simple generalizations to be developed. Some members of the Bureau should be able to offer such exchange collections illustrative of the life of Plains Indians, or of Pueblo Indians. Others may have missionary friends abroad who would prepare and send home say twenty-five sets of specimens illustrating Chinese or Japanese life, life in the South Sea Islands or in Africa. These could then be listed in the Bulletin for sale at a price which would fully repay the trouble of the collector as well as the actual expense incurred in procuring the specimens. P. E.

Geography at the National Educational Association

An important geographical contribution to the Proceedings of the National Educational Association was the paper entitled "The Relation of Physical Geography to Other Science Subjects," by Professor William Harmon Norton, Cornell College, Iowa. The author presents his subject from the standpoint of the geologist, making a somewhat broad but just claim that modern physical geography, as a science, was the work of the geologist and not of the traveller, the explorer, nor the geographer. Professor Norton's argument is to the effect that the subject has been restricted to the study of land forms, holding that it is so regarded by Penck, Boulangier, de Lapparent, Supan, and Davis. Notwithstanding that the consideration of landforms is an overlap-land between descriptive geography and geology, Professor Norton takes the ground that this aspect of the subject should be taught under the head of geology, the study which possesses the easier approach, the greater coherence, the better presentation, and the larger view. In other words, geology sets the content which it shares in proper perspective with geography. Professor Norton also takes the ground that both physiography and meteorology, while necessary and pertinent to educational systems, should not be included in the domain of physical geography, each being a science in itself.

Professor Norton pleads for a thoro course in physical geography together with more "regional" geography, such as has a place in German schools, concluding with meteorology and geology. He takes the ground that these, as earth sciences, should form a line of studies so closely articulated that they may be considered the vertebral column of secondary instruction.

In discussing this paper Mr. J. W. Redway said that were he required to define the term "physical geography" he should feel the requirement one of bewilderment. From the standpoint both of science and logic he believed that the limitation of the subject set by Professor Norton was correct. But considering the chaotic condition of courses of study it is often necessary to be illogical. The fundamental principles of physical geography include those which belong also to astronomy, to meteorology, to geology, and to physics. In order to understand the laws of climate the pupil must be familiar with some of the principles of astronomy, and these are more conveniently set forth in the pupil's text-book than in a separate volume; and so also with certain principles of the geography of the air, and the physics of the earth. It is more economic of time, and more convenient to be illogical and include them in the pupil's text-book.

In geology, what Professor Norton rightly terms the overlap-land is rather more perplexing to the teacher of physical geography. The study of physiographic forms is just as essential in the one science as in the other. The study of the flood plain, for instance, is an essential feature even in elementary geography, but the knowledge of it that does not include its origin and evolution is not of much value. Some of the principles of stratigraphy and historic geology are also essential to the study of physical geography, and the teacher must take the choice between supplementing it or omitting it, if the necessary matter does not happen to be contained in the text-book.

The introduction of the man element into geography has begun a revolution in the teaching of the subject, and the latter is pointing to a very definite end—namely, that regional geography, physical geography and meteorology are all correlated departments of earth science fundamental to geology, and that the latter is incomplete unless applied to economic geography.

A University Afloat

The following is part of a letter received from Mr. William B. Marshall, former curator of natural products in The Philadelphia Commercial Museum. His suggestion will certainly meet with the hearty approval of geographers. Space for discussion of the subject is gladly offered in The Bulletin.

******In discussing my recent address before the Chicago Academy of Sciences, Dr. Chamberlin of the University of Chicago, president of the Academy, said he thought it quite probable that in the near future the methods of transportation would be so improved and cheapened that pupils could by travel study the actual topography of the states and countries. This thought touches very closely upon one that I have had in mind for many years, and I write to you now to suggest that you open up a discussion of the question in the next issue of your Bulletin. My idea has been that some one of the wealthy universities, or a combination of several universities, could control and run a steamer. The expense would, of course, be great, but the advantages to be gained would likewise be great. In this day of Rockefellers, Carnegies, Armours, Stanfords, etc., finances should be no bar to an enterprise which promises educational advantages proportional to the outlay. A university afloat would have many**

advantages over one stationary. History, geography, languages, commerce, art, architecture, and other subjects could be taught in their homes, so to speak. To me it seems that a course of observation by travel should be considered an essential feature of every great university.

Very truly yours, WM. B. MARSHALL.

PHILADELPHIA, July 15, 1901.

Valleys in the Chicago Record-Herald

Another traveler has found and described valleys formed in the good old way that valleys had before there was a science of physiography. Mr. William E. Curtis, writing from Norway to the Chicago *Record-Herald* of August 16, says: "The western coast of Norway was once a mighty rock, a long single mountain of granite, which has been split into many sections, and the sides of the cañons thus created have been worn smooth by the waters that have been pounded against them for millions of years." Later he says, "Geologists declare that all these fjords have been carved out by glaciers"—but he evidently doesn't believe it.

Let us hope that in another generation or so travelers will have learned how valleys are formed, and will let these cataclysmic chasms drop into the background along with the nixies and kobolds that once inhabited them.

Commercial Geography

Adams' Commercial Geography, recently announced by the publishers, D. Appleton & Company of New York, deserves the hearty welcome it is receiving from teachers and superintendents. It is very carefully and accurately written, and contains numerous well-chosen illustrations, maps, and diagrams. The book can be strongly recommended to every progressive teacher of geography.

Civil Government in the Philippines

On the 4th of July, Judge Taft took the oath of office as the civil governor of the Philippines. Out of twenty-seven provinces only five remained under military control. The chief bone of contention has been the continuance of the friars in power. But it is reported from Rome that these friars will be gradually withdrawn, and priests from France and from America will be sent in their places.

The civil commission has called for hundreds of American teachers, and they are being sent out in large numbers. Their contracts call for three years service.

Progress Against Yellow Fever

The value of careful sanitation in tropical cities is well illustrated in the fact that in the last year, for the first time on record, there has not been a death reported from yellow fever in Cuba. The discovery, by our surgeons, that the disease is carried by the mosquito, makes it possible to combat the disease with some certainty of success, instead of blindly, as heretofore. It now seems to be definitely established that there is no infection direct, that fever patients may be cared for with impunity anywhere, provided only that the mosquito is exterminated, and the battle is on against the insect. This progress in the etiology of the disease is of the utmost importance, not only for Cuba, but for all tropical ports, and in a commercial as well as in a purely sanitary way.

Girl Slavery in China

Dr. Ida Kahn, a native of China, and one of the first Chinese women to receive a college education outside of her native country, contributes a very interesting article to the *Independent* of July 11, 1901, We quote some paragraphs.

"Slavery exists in China, and that to an appalling extent. So far as my observation goes, the girls of China furnish the victims, and the boys but very seldom. * * * True, the little slaves are not often obtruded upon your notice. You may gaze up and down all the streets without seeing one. * * * Who are the people that use slaves in China? I may answer, the rich people who regard them as indispensable as so many pieces of furniture. Accordingly they furnish them to each daughter of the house in quantity and quality corresponding to the length of the family purse. The daughter carries them to her future home as part of her dowry. * * * The middle classes use the slave girls because they cannot afford servants, and the poor people use them as a means of getting rich."

Death of Nordenskiold

Baron Adolf Erik Nordenskiold died at Stockholm, August 12, at the age of 69. He was one of the greatest of a long line of Arctic explorers. He made his first voyage in 1858, and in 1861 had charge of a party measuring an arc of meridian in Spitzbergen. But his most famous voyage was that of the "Vega" in 1878-9, with King Oscar as patron, and with the purpose of charting the northeast passage. "This voyage is one of the most interesting in Arctic history, and it alone would entitle its commander to imperishable fame."

Royal Koreans in America

The second son of the Emperor of Korea, Euiwha, has been a student in the Roanoke College, Virginia, since March, with two of his companions, and they are making very good progress in English.

—*The Independent.*

Sugar in Cuba

Gen. Wood reports that the latest Cuban sugar crop, which is a large one, was grown on only eight per cent. of the entire area of sugar land. This is very significant as to the future of sugar in Cuba, and in this country as well. Java last year led the world in the production of sugar cane, with an output of 722,000 tons. Cuba followed with 395,000 tons, Louisiana coming sixth on the list. But it must not be forgotten that beet sugar is gaining very rapidly on cane, and last year only one-third of the world's sugar came from sugar cane.

Controlling the Nile Floods

In 1885 Lord Cromer inaugurated extensive engineering works in upper Egypt for control of the flood waters of the Nile. Great dams have been building at Assuan and Assiut. These works will be completed the coming year, and long reaches of rich bottom land along the middle Nile will be able to produce two crops annually, instead of one, as the flood waters, being ponded back, can be liberated in canals for use in irrigation.

Now a further extension of this control is planned, the intention being to make catchment basins of some of the large lakes in Abyssinia and at the sources of the great river.

Industrial Progress in the South

Manufacturing plants are increasing more rapidly in Georgia than in Massachusetts. During the first six months of this year 1,818 miles of railway were laid in this country, of which 1,275 were laid in the South. The sudden leap of New Orleans to the rank of second city of exports in the United States cannot be accounted for on sentimental grounds. Trade moves inexorably along lines of least resistance. The exports from New Orleans during the fiscal year of 1900 were over $115,000,000. So far this year they are already $122,000,000. —*The Independent.*

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(Read foot-note on page 300)

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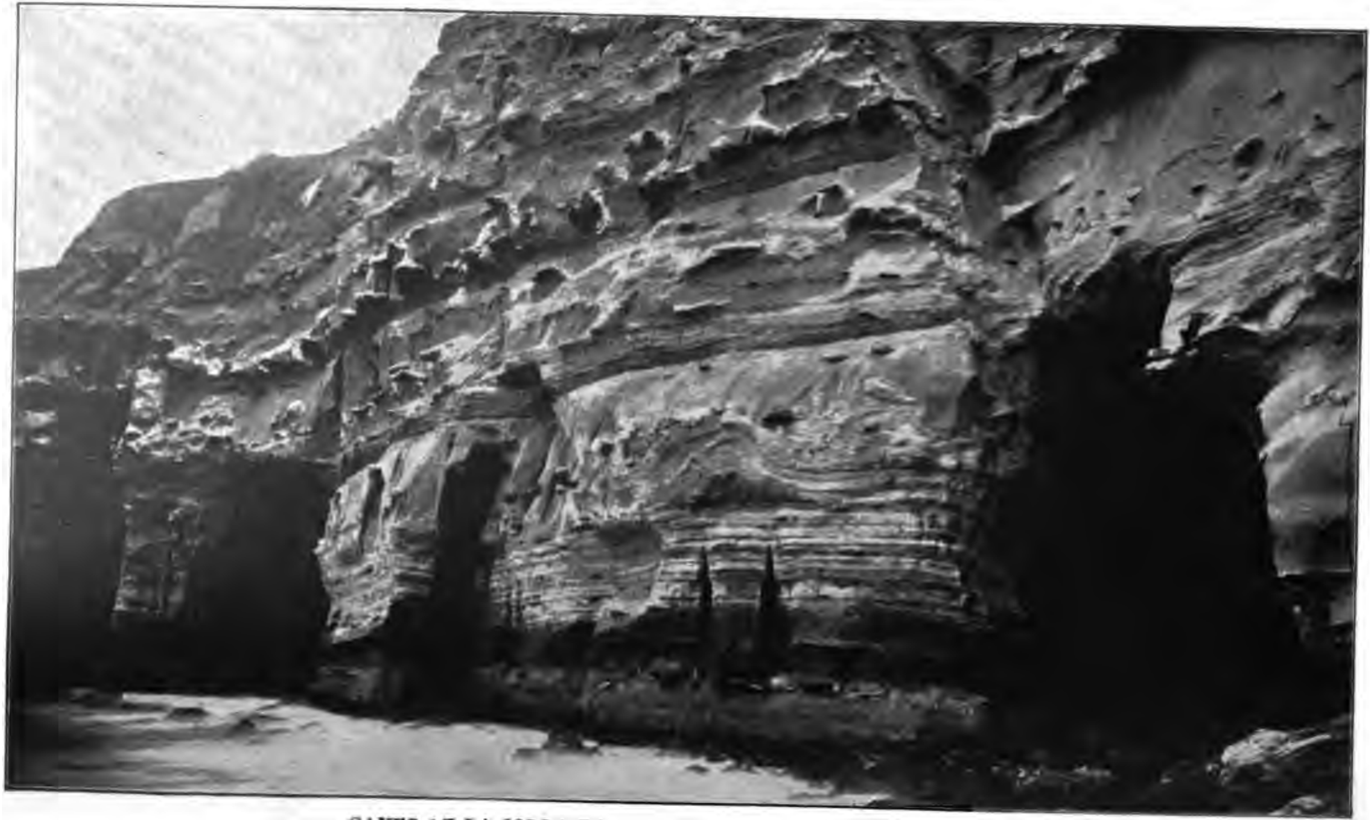

CAVES AT LA JOLLA PARK, NEAR SAN DIEGO, CALIFORNIA.

"The face of the cliff for a distance of several miles has been sculptured by the waves into most curious forms."

BULLETIN

OF THE

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GEOGRAPHY IN AMERICA*

A PLEA FOR ADVANCED GEOGRAPHIC TRAINING, AND FOR THE DEVELOPMENT OF ECONOMIC GEOGRAPHY

BY J. PAUL GOODE, PH. D.

SYNOPSIS

1. Sketch of the Development of Modern Geography.
2. Present Status of Geographic Instruction in Europe.
3. Status of Geography Teaching in America.
4. The Scope of General Geography.
5. A Proposed Outline of Economic Geography, and its Possibilities in Universities and Secondary Schools.

1. SKETCH OF THE DEVELOPMENT OF MODERN GEOGRAPHY

The wonderful century just passed outranked all its predecessors in the record of mental awakening, and in the growth of knowledge, especially in the fields of physical and natural science. Advance in any field of knowledge reacts on all the others, to enrich them, and be enriched by them in turn. The most remarkable progress in the latter half of the century, was in physics and chemistry, and in biology, due to the application of the universal principle of evolution.

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*Address read before the Chicago Geographic Society, April 6, 1901.

"Evolution is an integration—from an indefinite, incoherent, homogeneity, to a definite, coherent heterogeneity." Thus spake Herbert Spencer, and he builded a whole system of philosophy on the idea. And the law holds in every field ever offered to investigation. It is true in the general system of education, it is true in each separate branch of that system.

In the broad field of science, one by one the fundamental laws have been enunciated, and now and then a realm set aside as the special province of an individual science. Just now we are interested in geography, and we are watching it unfold, and assume coherent heterogeneity. Once a threefold division of the subject was sufficient; mathematical, physical, and political. But now we are older, and wiser; heterogeneity has set its stamp upon us, and to adapt our geographic organism to its widened environment we need a more complex classification. We need to amplify, and give coherence, integrity and high rank to lines of investigation once passed by with brief mention.

Geography has been one of the latest provinces of knowledge to be enfranchized, to have its monotonous homogeneity broken in upon, to have its laws enunciated and codified. But all things come to him who waits—and geography has waited.

The prospects of geography have suffered because of its name – "A description of the earth;" not the science of the earth, geology came in and captured that term. Fate seems to follow on a name. A criminal charge is made against a man—a false charge; and it becomes at once a potent factor in his environment. He can't evade it, and in despair he says at last," I have the name, I may as well have the game." It was so in geography, and our forbears made its name good. They recorded facts, made catalogs of them, and we had to learn them. "Ours not to reason why!"

But a mere catalog of facts is not a science, and in this age of organization, not to be a science is to be discredited. Humboldt and Ritter were doing great work in geography in the first half of the century, and with the right attitude. With them geography was being given its scientific aspect. Both these masters died in 1859. It was not until 1855 that Maury published his "Physical Geography of the Sea," thus laying the foundation of oceanography. It was not till 1856-59 that Ferrel published his papers on the theory of atmospheric motions, so making possible the science of meteorology. It was in the late '60s that Powell, Gilbert, and others began the work on land sculpture which founded the science of physiography. And it is only now, at the beginning of the new century, after "the enormous expansion of American, English, and German international trade; the acquisition of vast trans-oceanic possessions; with the sleepless instinct of gain that opens up markets in the most remote countries for the products of labor in farm and factory, quickened by ever increasing speed thru the aid of mechanical power, and the annihilation of distance by contrivances never dreamed of a few generations ago,"* that the human interest is being more and more magnified, and an effective demand made for the differentiation of a new individual—economic geography, a study which will take as data, the laws established in geology, physiography and meteorology, and show how these laws become potent, directive influences in man's economic and social devlopment.

The best work in geography and the most of it, so far as we can judge at this distance, has usually been done by the Germans. Other nations have had their great discoverers and their exploring expeditions, but the scholarly work in quantity, and the widespread interest in geographic subjects among the people, have been with Germany from an early date.

The reason is not far to seek. Ritter was professor of geography in the University of Berlin, as early as 1820, tho his was the only chair of geography in Germany up to his death in 1850. He was a master teacher, and immensely popular. He organized the Berlin Geographical Society in 1828, the second of its kind in Europe. He was the founder of physical geography as studied the major part of last century. He was the intellectual father of a host of great geographers; and it was his pupil, Arnold Guyot, who brought a second edition of his master's enthusiasm to America, and made us acquainted with the manner of his great teacher's thought, in his own "Earth and Man."

Ritter has been followed in the University of Berlin by such eminent men as Heinrich Kiepert and Baron Richthofen. Many other German universities have followed the lead of Berlin, in establishing chairs of geography. So in Germany, teachers in the secondary schools, have had the benefit of thoro university training in geography for eighty years. And teachers teach well what they know well.

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*Dr. A. J. Herbertson, Applied Geography, U. S. Rept. Com. Edn. 1898-9 I. 1189.

This growth of geography in Germany is part of a revolution in the theories of education which has been in successful progress there thru the major part of the century. The great idea that has been gaining ground is, that that education is of most worth which best fits each person for the life he has to live. This was the thought that established technical and trade schools, and departments of science in all the universities. It was the wisdom of the idea, and the success of the revolution which have kept Germany in the forefront of scientific education thru all these years, and which today make her the most ambitious commercial power in the world, not even excepting ourselves. Germany is now conspicuously reaping the reward of persistent, scientific education.

Now notice how different has been the trend of events in Anglo-Saxon lands. Science has barely yet crossed the threshold of Oxford. Cambridge can boast some great names in physics, and in some other science lines, yet the amount of science work done there is ridiculously small compared with the German, or even many American universities. Technological institutions have been very slow of establishment, and are today utterly inadequate to do for Great Britain what is being done for Germany. Almost up to date England has maintained her commercial supremacy by main strength and awkwardness, as it were. But the time is rapidly passing when the world's commerce can be held by an untrained mob. The trained legions of Germany are setting a pace. Tariff walls, and armies to stand guard over the trade of nations, or even the traffic with "the heathen in distant lands" and the "persons who sit in darkness" are mediæval institutions, or worse, and they protect and conserve mediocrity by recourse to brute strength.

The proper reply to Germany's invasion of the world's markets, is not tariffs and armies, but thoro, scientific, commercial education, from the bottom up—or from the top down. And the order is very significant. Germany has been doing it for eighty years from the top down. First brilliant work in the universities, then well trained graduates who go, loaded to the brim, with a live, practical, scientific education, into the secondary schools, the influence trickling down to the lowest forms.

2. THE STATUS OF GEOGRAPHIC INSTRUCTION IN EUROPE

The latest report of geography in German universities shows that in the winter semester 1899-1900, there were chairs of geography in twenty German universities. with a total of 108 instructors. Berlin stands at the head of this list, with twenty-eight instructors, and Leipzig comes next, with twelve. Austria has chairs in eight universities, Vienna at the head, with eleven instructors. Switzerland reports three universities; and these three countries have almost 150 university instructors in geography.

In addition to the university work, nearly as large a list is shown in academies and technical high schools. At Magdeburg, for example, commercial science is taught exclusively. The professional consuls, which Germany employs exclusively, must be graduates of such institutions or courses.

In France there are chairs of geography in twelve universities. In Italy also, there are twelve universities, with chairs of geography. And in all these lands, the chairs are filled with men under pay, and with equal rank with other university chairs.

But in Anglo-Saxon lands, whose people pride themselves on their initiative, and progressive ideas, the movement toward educational freedom has been slow. There has never yet been a chair of geography in a British university. There have been only two or three so far in American universities, and the occupants have been usually loaded down with some other work.

The Royal Geographic Society a dozen years ago tried to rouse some interest in geography teaching in England. They wanted to start a department of geography in some one of the universities. They chose Oxford, and they had to promise to support the department for ten years, at the end of which time, the university was to undertake the support, by maintaining a "reader" in geography. Now there is at Oxford a "School of Geography," with four men on the staff, and the head of the department ranks only as a "reader." And last year, there were about 100 students enrolled, and nine courses offered, three of which directly touch the field of economic geography. Lectures have been given at Owens college, Manchester, at Herriot Watt college, Edinburg,h and at a few other places, and a plan for teaching economic geography in the University of London is under consideration.

In spite of this scanty showing in university recognition in

Great Britain, there has been in the last five years a very extensive call for commercial, economic, or industrial geography in secondary schools, evening schools, and University Extension courses. The demand is effective, and classes have been kept busy, but with widely varying notions of what ought to be taught, or how best to teach it, and the teachers have had practically no opportunity to acquire proper training.

3. STATUS OF GEOGRAPHY TEACHING IN AMERICA

What is true in Great Britain is largely true with us. There is a widespread demand for the geography of commerce in many high schools, and commercial schools all over America, and very scanty provision in the universities for geography in general, what is offered usually being in the line of physiography, almost no provision for commercial geography being made. Colleges of commerce have been organized in half a dozen of our leading universities, but they are all more or less on paper still, and an all around preparation for geography teaching is not yet offered in any of them.

And we need not yet lift up our eyes to the normal schools. Our help will not come from them. So long as the practice endures of giving so-called "methods" on scant subject matter, attempting to make pupils wise by short cuts; so long as geography gets one term as one of five or six subjects carried abreast, as is often the case in our best normal schools; so long as normal school teachers are given twice as much class work as can be done well—however high an ambition the normal school teacher may have, he is practically barred from realizing it in any measure.

In the conventional secondary schools, Latin is offered consecutively for four or five years, and is usually taught by those who have themselves had such a course, and in addition have had a college training in the subject. In a few of our best schools, English has almost an equal chance. In these very schools, geography has from one to three terms, or none, as the case may be. The great majority of our grade teachers stop short in their preparation with this secondary education, with sometimes a year or so of normal school work.

These students with the long course in Latin, come back to the grades, where Latin is not taught at all. These same students with next to no higher training in geography, come back to the grades where geography is taught from two to eight years. *Teachers teach well what they know well.*

Now these things ought not so to be, and we, geographers, are the people who need to be heard from. If our educational fathers are wise, they will see that it is not for nothing that this widespread demand for commercial education has arisen; that it is the highest wisdom to educate our boys and girls for the life they have to live. And the ninety and the nine of them have to live in a world of constantly growing commercial activity. It is only the residual one who is destined to dwell on lofty Olympus in a land of dreams. And however beautiful such a life may be, we as a nation cannot afford to indulge in too much hasheesh. There are yet worlds to conquer, and there are powerful competitors in the field as England is finding out. That the fittest will survive in this competition, we may be sure; it is the cosmic process. To indulge now in tariffs and armies, is to take a step backward. It is to grow a carapace, rather than a brain, a line of evolution tried and found wanting in Paleozoic time. We spent in the United States, last year, they tell us, $200,000,000 for education, and $400,000,000 for war—in times of peace! Think what it would mean to reverse that ratio!

In Germany, Holland, and Belgium consuls are required to have the training of the commercial college. Belgium demands a graduate from a three years' course. Three years ago there was established in the University of Brussels, an institute of geography, really a college, with the famous geographer, Eliseé Reclus at its head and with eleven trained assistants*.

They have planned the geography course, in the words of the prospectus, "in what appears to be the most logical order, conformably to the ideas of every geographer who would at the same time be a man of science, a scholar, and a good worker." This program demands preliminary courses in natural history, chemistry and physics, mathematics, elementary geography, history, the English, German, and Neo-Latin languages, and Russian. The first year at the institute demands fifteen hours per week, the two succeeding years being similarly occupied.

The Italian government subsidizes commercial training in the colleges to equip its consuls. How are our consuls chosen, and what training have they had?

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*Geog. Jour. Vol. 12, p. 84.

President Eliot in an address at the opening of the recent Philadelphia Export Exposition, said: "We have so long regarded consulships as mere political prizes, that we have lost sight of their real function as commercial agencies. If this country is to enter seriously into competition for international trade the world over, the very first administrative reform needed in our government, is the conversion of consulships into commercial intelligence bureaus. It is obvious, however, that the men who are to discharge this function, should have a first rate training in several of the subjects I have enumerated as appropriate to an upper commercial school."* Out of his list of twenty-one subjects named, eight or nine would be classified as physical or commercial geography.

Our fathers must see that in the matter of technological and commercial training, it would far better become them to lead in popular education than to follow, to emulate our German cousins, rather than our Anglo-Saxon relatives, to establish commercial education extensively, and from the top down.

4. THE SCOPE OF GENERAL GEOGRAPHY

An ideal preparation in geography is a liberal education of a rather high order. It involves at least an elementary acquaintance with what may at first appear to be a startling list of sciences; physics, chemistry, astronomy, geology, physiography, meteorology, biology, anthropology, economics, politics, sociology, and general geography. In three or four of these the instruction should be intensive and somewhat extended. Such an education would produce teachers who could do profitable work in normal and secondary schools. And the work, as then offered in these schools, could be given with some power, putting proper emphasis on the several subdivisions of the general subject. These subdivisions are:

First. Mathematical geography and cartography; the attitude of the earth to the sun and other heavenly bodies, laying the bases for all future work in climate; the measurement of the earth, and the charting of its surface.

Second. Pysiography of the lands; the processes and results of land sculpture.

Third. Meteorology. The general atmospheric circulation, and the seasonal and occasional interruptions in it, with attendant changes in temperature and humidity.

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* Rept. U. S. Com. Edn. 1898-0, I. p. 680.

Fourth. Oceanography. The oceanic circulations with their influences in climate and commerce.

Fifth. Biogeography. The distributions of plant and animal life, as a natural outgrowth of geographic conditions.

Sixth. Anthropogeography. The same principles applied to mankind, and which might include what ordinarily passes as political geography.

Seventh. Economic geography. A study of the reactions between man and his physical environment, that is, his economic and social adjustment to it.

This makes a logical sequence from low to high, from the less to the more heterogeneous. It puts underneath life, in its distributions and inter-relations, the fundamental physical factors of its environment. The student is prepared to look upon the phenomena in which human life is a factor, as being very complex, a historical event as being the resultant of many causes, man's physical environment being an ever present factor. Such a preparation carried into the study of history will produce very different results in historic interpretation from much of what we have been accustomed to in the past. History will cease to be a mere narrative of events, and under every event we will carefully look for directive causes in the physiographic and economic environment.

5. A PROPOSED OUTLINE OF ECONOMIC GEOGRAPHY, AND ITS POSSIBILITIES IN UNIVERSITIES AND SECONDARY SCHOOLS

Economic geography by this perspective is worthy of presentation as high grade university work, where teachers, consuls, and specialists may receive adequate training, where a good general view of the field may be obtained by those who are to follow commercial careers, and where the proper training may be given the future student in history, economics, politics, and sociology.

Let it follow on the broad foundation indicated, in the six preceding departments of general geography. We have a field which lends itself to outline as follows:

SYNOPSIS OF ECONOMIC GEOGRAPHY

Part 1. Commerce.

1. Transportation.
    - Theory of transportation.
    - Railways.

    - Steamships and routes.
    - Canals.
    - Common roads.
2. Communication.
    - The post.
    - The telegraph.
    - The telephone.
3. Trade relations.
    - Banking and exchange.
    - Organized capital.
    - Monopolies, trusts, etc.
    - Organized labor.
    - State interference and control.
4. Commercial cities and concentration of population and industries.
5. History of commerce.

Part II. Commodities.

1. Natural resources.
    - Economic geology.
    - Economic botany.
    - Economic zoology.
2. The great industries. (Processes.)
    - Agriculture, dairying, grazing.
    - Food preparation.
        - Meat packing, fruit canning, beverages.
    - The textile and clothing industries.
        - Including leather and furs.
    - The fictile arts.
        - Glass, pottery, brick, etc.
    - The lumber industry.
    - The iron industry.
    - Paper and printing.
    - Chemical industries.
    - Selected manufactures.
        - Machinery, etc.
    - Sources and applications of power.
        - From water, winds, and chemical and other agencies.

This field in university treatment will divide itself easily into courses in commerce and industry, and lends itself to presentation by lectures and research work in the ordinary way.

In secondary schools the field is very inviting as the work of a term or more, as the time will allow, coming in the high school at the end of the other geography work. It could be a text book course, provided there were suitable texts available; but even in such a school the best work will be done in the form of research work known as the topical method.

The subject lends itself to presentation in quasi-laboratory form, by the excursion, which may be made a very valuable instrument of instruction.

Large library facilities are not available for all our high schools, but the magazines are. Look over the files of our magazines, from the "Atlantic" and "North American Review" down, and notice the prominence and increasing representation of subjects which will be classified as general geography, and especially as economic geography. Even the "Cosmopolitan" and "Munsey's" have valuable material. "Harper's Weekly" has occasionally valuable articles. For our purpose no better general magazine is printed than the "Review of Reviews," and with it in the same field must be mentioned "The World's Work." By far the best weekly magazines are the "New York Independent," and "The Outlook." These papers give an impartial and unbiased summary of the week's events, so much of which is of geographical interest.

Not people enough realize the great mass of valuable material in our government publications, those of particular worth being the reports of the various agricultural bureaus, of the geological survey, of the treasury department, of the American Republics bureau, and of the consular service.

The topical method is practicable with this material, in the high school, and even in the grades. A course of such work from the grammar grades thru the high school will bear very valuable fruit in the wide and healthy interests it will create in our boys and girls, for sane and educative subjects of thought. A widespread and careful training of this character for a generation will go far in the encouragement of healthy journalism, and toward the discouragement of the worthless and vicious daily paper, with its rakings and scrapings of all the crime and vice and scandal, and will help to multiply such papers as the "Boston Transcript" and "New York Post."

Our boys and girls, led into the wealth of subjects of vital importance in municipal, and national economy, will have no time for the rot of crime dished up so lavishly in our current press.

I think no one will deny that the field of economic geography as outlined is very rich. As a means of wide culture, the field of general geography is unsurpassed. As a special field for research and careful study, economic geography is absolutely essential as a preparation for the consul, the commercial traveler, trade journalist, business man, and statesman of the future. More and more the principles of geography are seen to be fundamental and ever present factors in historic, economic, and social development. We need to make no apologies for the subject in general, nor for the special department for which this paper is pleading.

DEVELOPMENT OF THE CHILD'S SOCIAL NATURE THRU GEOGRAPHY AND HISTORY

BY CHARLES P. SINNOTT.

Education is for the individual and for society. Popular government can be preserved only thru intelligent citizenship. On this solid foundation rests the argument for the support of our public school system. The development of the individual regardless of his relation to society is not enough, but his development thru training for good citizenship is the ideal for a democracy.

It may be helpful for us, as we begin our thought upon this subject, to trace in a general way the development of the child as a member of society.

In the early days, months, and years of the child's life he is an extremely self centered being, and rightly so, as his sole problem at this time is to keep alive and grow. One of his earliest spoken words is "my," and he remains for a long time extremely partial to the personal pronoun in the first person singular. To be sure he never entirely outgrows this egoism but he finally subordinates it. He early comes to recognize the fact that he has certain great needs which he alone cannot supply, that he is dependent upon others, and that he cannot live alone. There opens up to him, therefore, a new problem, that of learning to live with other people. This problem is not solved at once but is gradually worked out in the home, on the playground, in the schoolroom and community. Thru his play and work he finally comes to recognize the rights of others, to learn the great lesson of co-operation and to see the necessity of self denial, self control, and conformity to regulation or law. In such simple experiences he comes to a practical realization of some of the fundamental requirements of social life and learns how to adjust himself to them.

Our problem in the present instance is to determine if possible how the geography and history may be made to help the child in his preparation for this social life; for the great problem of education is, after all, to fit for true living and all the subjects of the school curriculum should be made to contribute to this great end. Whether our school system, as a whole, might not be so modified as to contribute more directly and effectively to the needs of society is an open question but not one for consideration in the present instance.

Taking our school system, however, as it is today, we may fairly claim for the geography and history that they are important aids in the development of the child's social nature. His life experience, however, must continue to be the most effective agent in this development.

Geography has been defined as the knowledge of the earth as the home of man. It is much more than the knowledge of mere location as some would have us believe. It is a many sided subject and when properly taught appeals to the many sided interest of the child. History and geography go hand in hand and are practically inseparable in teaching. We may think of geography as showing what man *is* doing with his environment while the history shows what he *has done* with it.

As the child is to become a member of society and a part of it he must come into sympathetic relations with his social environment. And by his social environment we mean much more than his immediate physical surroundings. It includes all of those conditions whether near at hand or far away which have in any way contributed to his comfort or happiness. It is of prime importance, therefore, that the child should come to know of those conditions which have operated to make his environment what it is. Much of the social unrest of today comes from the fact that people do not understand the great underlying principles regulating community life, and therefore cannot fully appreciate the difficulties in connection with the solution of the great social problems as they present themselves. Misunderstandings and hard feelings therefore result, and in place of intelligent and helpful co-operation come unfortunate envy and strife. It should be the aim of the school, therefore, to so enlarge the social horizon of the child that he may see, in their true relations, the great elements that enter into social life. Under such instruction the child should come to realize something of the extent to which the individual is dependent upon society and thus come to an appreciative study of the great industries and institutions among men. It is at this point particularly that the geography and history come to our aid.

In the remainder of this article it will be necessary to confine our thought to the study of the great industries as necessary to the development of the child's social nature, and to leave the great institutions, political, religious, and educational, for the reader to think thru in his own way.

If the child is to come into right relations to the great industrial world about him it is necessary that he should know much about it. He should be led, therefore, to see how the various occupations have sprung from the needs of people, and should trace the development of such great industries as hunting, fishing, grazing, farming, mining, lumbering, manufacturing, and trading from their simple beginnings to their present complex conditions. He should see that as a people advance in the scale of civilization that their needs are greatly multiplied and that they become more and more dependent upon other people near at hand or far away.

The child is naturally interested in stories of child life, and this should furnish an excellent starting point for his study.

Juvenile literature today abounds in stories of child life among such primitive people as the Indians, Eskimo, and Arabs. These beautiful stories either read to or by the child give pictures of life conditions in their simplest forms and he becomes able to appreciate, in a measure at least, the primitive conditions of his own race. The study of such a simple people reveals the fact that their needs are few and that there is little necessity for a variety of occupations. The child, however, becomes intensely interested in determining how the necessities, comforts, and pleasures of life among such a people are provided. He sees that among these crude people, as among those more highly civilized, there is a constant struggle for the bare necessities of life such as food, clothing, and shelter, and it is a constant source of delight to him to see the simple means employed in providing for their daily wants. It is this adaptation of simple means to a great end, more than the element of adventure, that makes the story of Robinson Crusoe so attractive to the average boy.

We have in these simple modes of life, the beginnings of the great industries, and it would seem desirable, therefore, that these ideas should be very definitely developed, and this would naturally call for a large use of good literature and pictures, both of which are now so easily obtained. One can hardly think of a more interesting and profitable field for reading and study than this. The children are thus acquiring ideas that are absolutely fundamental in much of the work that they will take later in the more advanced phases of their study. Such a use of literature and pictures as we have referred to should do much toward establishing the reading habit and the love for the best in literature. With such a habit and taste delevoped in the child he is in the way of rapid and wholesome development.

The simple historical story may be used in a similar way. The story element in history, as in geography, should constitute a prominent part of the work. This is particularly true in the early stages of the study. Stories of child life in the olden days strongly appeal to the child of today and the knowledge gained thru such stories helps him to see how the complex occupations of today are but the development of the simple industries of the past.

From such a line of reading and thought the child comes to the study of his own needs and those of his community with added interest and intelligence. He naturally comes to compare his own needs with those of his Indian, Eskimo, and Arab friends and easily realizes that his own are much more complex. His primitive friends are able to procure nearly all of the necessities of life by their own personal exertion, while in his own case he sees that a multitude of people in his community are at work, directly or indirectly ministering to his needs. He is thus led naturally to the study of local industries. He sees also, with equal clearness, that there are many necessities of life which cannot possibly be provided by the labor of those in his immediate locality, and he thus becomes interested in the study of the great industries beyond his immediate field of vision.

In all of this study he comes to see the necessity of the division of labor, the use of machinery, the establishment of great enterprises calling for the concentration of capital and recognizes that capital and labor are dependent one upon the other. The history of these great industries and their relation to the development of the country should furnish an exceedingly interesting and profitable line of study, all of which should create in the child's mind a wholesome respect for labor.

In this development of the child's industrial concept good literature should play an important part, but it would be a serious mistake for the teacher to depend upon the book alone. The great industrial world about us, touching us at so many points in daily life, should furnish many valuable lines for objective study, and as the child develops, this line of work should have an increasing fascination for him. That teacher is therefore wise who so shapes the geography excursion as to make it include not only the natural objects of the community but the local industries as well, and who so directs the geographical and historical reading as to make it contribute directly toward the solution of both the physical and social problems connected with the study, remembering ever that the facts of the lessons are useful only as they contribute to the child's development.

OBSERVATION WORK IN ASTRONOMICAL GEOGRAPHY

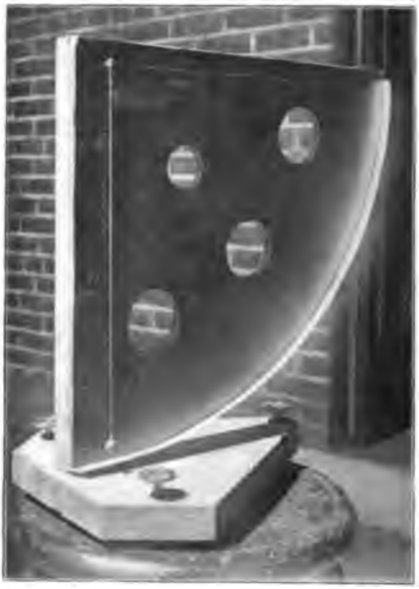
BY R. S. HOLWAY

By the use of the crude instrument shown in the accompanying illustration any bright student in the secondary schools can find out how much the axis of our earth is inclined to the invisible plane in which it revolves about the sun, thus determining the position of the tropics and the polar circles, or he can measure the size of the earth. The accuracy of his results will also compare favorably with the accuracy commonly obtained in other high school sciences.

Various heliotropes have been described in recent journals, and the one shown here is offered merely as a very simple and efficient form of this necessary instrument.

The cut is almost self explanatory. The stiff cardboard slip for the edge of the quadrant is marked off into ninety quarter-inches as an easy way to get even divisions for the degrees. The radius that will give this quadrant—a trifle over fourteen and five-sixteenths inches—is used to describe the arc from the vertex of a right angle laid off on a suitable board. This is then cut out and mounted on any convenient base. Leveling screws were put into the base of this instrument. Some of the students in making similar instruments used large screw-eyes for leveling screws putting them into the under side of the base. Others leveled their heliotropes by using wooden wedges. After putting the graduated slip in place the instrument is completed by inserting a small screw-eye at the vertex of the right angle and suspending from it a lead bullet as a plumb bob.

The heliotrope is used to take the elevation of the sun above the horizon. To do this, set the instrument in the sunshine with the graduated arc turned from the sun and so the shadow of the screw-eye at the vertex of the right angle will fall on the graduated arc. The instrument ***must be carefully leveled*** so that the plumb line hangs just in front of the vertical leg of the right angle and also parallel to the face of the board. It is easily seen that at sunrise when the sun is just on the horizon the shadow of the little screw-eye will strike the scale at the end of the horizontal leg of the right angle. This point is marked zero degrees. If the sun were directly overhead the shadow of the screw-eye would fall on the scale at the end of the vertical leg. This is then the ninety degree point. Numbering every tenth degree on the scale the heliotrope is complete. Evidently then the shadow of the screw-eye when the instrument is properly set marks the elevation of the sun above the horizon.



From a Photograph of the Apparatus used by Prof. Holway.

The pupils are set at work measuring the highest noon elevation of the sun to determine the amount and whether it is constant or not. In the meanwhile a great deal of laboratory work is done preparatory to the solution of the problems mentioned in the first paragraph. A gyroscope is set in motion and handled by each pupil that all may actually feel that it is difficult to change the direction of the axis of a rotating body. In the absence of a gyroscope the front wheel of a bicycle may be lifted and turned by the handle bars—first when the wheel is still and then when it is rapidly rotating. The resistance in the second case will teach that, if a planet while revolving around the sun is rotating on an axis, the direction of that axis will not easily be changed.

Having this principle in mind the students are set to carrying planets around central suns and to finding where the vertical sunshine falls. They begin with an earth with its axis perpendicular to the plane of its orbit. Here they naturally keep the axis always parallel to its first position and soon see that such a planet has vertical sunshine always at the equator and never anywhere else. With a little more effort they learn to calculate the noon altitude of the sun for people at other latitudes and find that there is no variation for any one place and consequently no change of seasons. Next they are given a planet with its axis inclined say 10° from the perpendicular to the plane of its orbit. In this case many of them need to be reminded that the gyroscope experiment teaches that the axis will remain parallel to its first position. Remembering this they find that vertical sunshine is sometimes 10° north of the equator and sometimes 10° south and that on such a planet there is a torrid zone 20° wide. The rest of the problems concerning the other zones are then quite easy. When they can take a globe, and, being given the inclination of the axis, carry it around the sun and explain the change of seasons and give the width of the various zones, they attack the problem of our own earth. Their recorded observations of the sun's elevation at noon show that there is constant variation and that consequently our earth is not one with its axis perpendicular to the plane of its orbit. The rest of the problem is simply the long wait to find the highest and the lowest noon elevation of the sun. One of the poorer results was as follows: Lowest elevation in December, 29°; highest in June, 77°; difference, 48°. This gives of course 24° for the inclination of the axis. The best result was 23.4°. I have checked their readings of the elevation of the sun with a good transit, and find that the most careful students can read correctly to two tenths of a degree for outside error. This is done by those students who pay the greatest attention to the leveling of the instrument.

At this stage of the work there is an opportunity for many interesting problems as to latitude and noon elevation of the sun on various planets at given locations.

Another very interesting use of the heliotrope depends on two observers being at two different stations one of which is some distance north of the other. I happened to attend a teachers' institute at Lakeport, 117 miles north of San Jose. I carried with me a heliotrope and read the noon elevation of the sun while my students read it at home. Averaging the results for two days they found the sun 39.35° high where I found it 37.65°. The difference 1.7° is the amount that the surface of the earth curves in going 117 miles. Calculation shows that at this rate to make the surface of the earth curve the 360° of the full circuit, one would have to go 24,776 miles—a remarkably close measure of the circumference of the earth. It is only proper to add that in this case the student who read the heliotrope spent some time in practicing with me the setting and reading of our instruments until we were fairly skillful. Another trial with stations only 70 miles apart and opportunity for only one hurried reading gave .9 of a degree difference which gives the large result of 28,000 miles for the circumference of the earth. The accuracy of the result in this problem increases rapidly as the distance between the stations increases. It may be well to add that the two stations need not be in exactly the same meridian provided that only the north and south distance is measured. In each of our trials we disregarded the amount one station is east of the other. Of course each took the *highest* elevation of the sun—not the elevation at twelve o'clock. The north and south distance we took from the land surveyors by getting the township and range of each station.

The whole point of the work, it will be seen, is to put the student into the attitude of the reasoning observer. These special problems are in my judgment particularly valuable. Their solution when they are first stated seems to the student so extremely difficult that their final solution strongly impresses him with the power of the human mind to reach out into apparently impossible fields. This gives to the young student a consciousness of power which is the very best stimulus to greater activity.

GEOGRAPHY AND LITERATURE

BY SARA D. JENKINS

"Whate'er betide we'll turn aside,
To view the braes of Yarrow."

The educational pendulum swings ever from extreme to extreme. For generations in the study of geography, memory was the only activity, locality the only theme, and the question "where" the teaching instrument. In barren textbooks, the great army of boys and girls bent on exploration sought incessantly rivers and towns, counties and countries which, for these inquiring minds, had no existence except on paper. The educational product was a confused impression of cabalistic lines and points on checkered pages of bad color.

The teaching world is familiar with the sharp recoil from mediæval to modern method; familiar with the rejection of formal memory, and the substitution of the almost equally invidious sense realism. One idol has been cast down that another might take the place. Today everything must be accounted for in terms of science. and the old "where" is displaced by the scientific "why."

No one will deny that a sound knowledge of geography must be based upon the biological sciences, and that the teacher of geography must be a scientist; but do even these conditions necessarily secure to the child knowledge of the most worth? Is the material side of the subject the possession of highest import? Have there been built in consciousness pictures of the wide, wonderful world, more valuable than those given by great writers of prose and verse? Has the teacher of literature no part to play in making our boys and girls cosmopolitan?

If geography be travel by proxy, who but the teacher of English can show

"The ice rimmed isles,
The palm-fringed summer seas?

Who will make heard

> "The plaintive Nubian songs again,
> The mule bells tinkling down the mountain paths of Spain."

or cause to be seen

> "Faith flowered in minster stones.
> Art's guess at truth and beauty."

If the office of a symbol is to call up an image, the English teacher should make the past re-echo at the footfall of a word. Only a small area of the earth's surface will ever be spread before the eyes of the mass of mankind. It then follows that the imagination must be employed to make the earth's inhabitants familiar with the home of man, and with the field of the deeds of man. If the majority of the people is ever to see this oneness, to read with delight, literature must lend a most important hand.

Textbooks of geography, however good, can never meet the literary requirement. To prove this, let any tourist observe or recall his experience when in distant parts of his own country or in foreign lands. "London on the Thames is the capital of England" may have been repeated since childhood, but when within the city, it is Shakespeare, Milton, Addison, Macaulay, Scott, Thackeray, and Dickens—poets, novelists, historians, and essayists—who have made London known and loved of all the world.

Geography, well taught, has no peer in informing the spirit, in touching the sympathies, in leaving a tone of the eternal melodies in the heart of the learner. The vitalizing centers of the world should so live in the memory that every fact concerning them is charged with articulate harmony. As the traveler roams about Warwick and Kenilworth Castle, is it the text of geography that is remembered, or Scott's Kenilworth? What would London be without Westminster, and what Westminster without the poets' corner and the royal chapels? To him who must see, if ăt all, the world by the fireside, what would Westminster mean without the pen of Addison and of Irving throwing on the canvas of consciousness, impressions both spiritual and material? Venice without Portia and Shylock is inconceivable, but the Venice of romance is completed only by the Brownings, by Ruskin, Mrs. Olyphant, and even by that prince of modern realists, Howells. Fiesolé must be made fragrant with memories of Milton and Gallileo. Paris is poor, modern, empty, unless infilled and made historic by that read of Napoleon, Josephine, Marie Antoinette, Eugénie, Victor Hugo, and "Jean Valjean." It is not "the clean paved streets, the bright shop windows, the gay throng, the city that manufactures toys and small wares," but the historic Paris that delights. It is the isle in the Seine about which Paris grew, Notre Dame, the Louvre, Place de la Concorde, the Bastile, and the Tuilleries, down the steps of which we see the unhappy Josephine, robed in black, pass for the last time on her way to Malmaison.

No lesson to study environment, no field excursion, can take the place of

"Lake Leman lies by Chillon's walls,
Which round about the rose enthralls."

When standing before the campanile at Pisa, or when reading of it in the seclusion of home, imagination must lift us on her "wing divine" that we may see Pisa's greatness rise from the sepulchral past. Florence without Dante and Petrarch is impossible.

The geography of the earth can no more be known unrelated to the human interest with which every nook and corner is invested, than the history and experience of man can be known apart from the globe he inhabits. Scotland's history cannot be known or understood without her songs, and her soil gave birth to her songs. He who would attempt to teach geography without literature or literature without geography, the gods should destroy; for in all countries the land and the water, the streets, churches, palaces, and battlefields show the thought of man expressed in deeds. Then, even tho a little science fly out, open the door wide to poetry, to classic fiction, to noble biography. There will never be too much, never enough, sentiment in the the school room. Tennyson by his Balaklava has won victories for England, and by his Ode on the death of Wellington, has made heroes the world over. What a lesson in patriotism is,

"Bury the Great Duke,
With an Empire's Lamentation."

In a word—man to be "man thinking" must hold relationship with the life of things as opposed to their phenomena. The true end of literary education, whether in geography or elsewhere, is the cultivation of the assimilating power. Every man, every book, everything continues to live by virtue of that which is independent of time and of place, and maintains its educative power long after the cause has ceased to exist. This constitutes the essential life the spiritualized thought, as opposed to thought without warmth or color. A profound sympathy with this essential life is the only means by which to quicken spirit.

Geography is made too much a knowledge subject. The school, the whole world is suffering from a great struggle for knowledge of material things. Present education has too little spiritward tendency; it ignores the importance of that responsive personality, by means of which one may sit in darkness and see the whole world.

AN OBJECT LESSON ON MEXICO

SISAL HEMP AND OTHER USEFUL PRODUCTS OF THE CENTURY PLANT FAMILY

BY WILLIAM B. MARSHALL

MATERIALS NEEDED

Specimens.

1. *Agave plants.* These are usually obtainable in the greenhouses and gardens of the neighborhood or could be borrowed for a few days; or a few plants could be kept in pots at the school building. It would be well to have several species, preferably the common Century plant, *Agave Americana,* the sisal hemp or henequen plant, *Agave sisalana,* and the tampico hemp plant, *Agave heteracantha.* If plants are unobtainable the next best thing is to obtain a few leaves and allow them to dry, or preserve them in a jar in a solution of formaldehyde.*

2. *Agave leaf combed out to show the fiber.* Select a medium sized leaf preferably of the sisal hemp plant, *Agave sisalana,* altho the leaf of the common century plant or any other species will serve nearly as well. Cut it off at the lower end to a length of about twelve or fourteen inches. Crush it with a rolling pin or a mallet. Keep wet with water. Comb away the pulp from the entire leaf except about four inches near the point. Use a steel comb, and be careful not to tear away the fibers. The specimen should then be preserved in a tall jar of formaldehyde solution.

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*Formaldehyde can be obtained at any drug store. The solution should be six per cent. formaldehyde and ninety-four per cent water. The solution should cover the entire specimen.

3. *Needle and thread of the spine and a few strands of fiber.* This is prepared in the same manner as the foregoing, except that the pulp of the entire leaf is to be combed away, leaving only a few strands of fiber attached to the sharp spine at the top of the leaf. This specimen should be dried.

4. *The rootstock of an Agave.* That of *Agave saponaria* is to be preferred as being the species used as a soap substitute. This specimen may be dried or preserved in formaldehyde solution.

5. *A hank of sisal hemp.* This may be obtained at the cordage works.

6. *Sisal cordage.* This should include a ball of binder twine and pieces of several sizes of rope each about a foot long. These may be obtained at the cordage works and from dealers in cordage.

7. *Door mat, floor mat, and hammock made of sisal.* These may sometimes be obtained in department stores. The mats may be obtained from dealers in carpets and rugs.

8. *Bagging or burlap made of sisal.* This may be obtained from the importers of Mexican goods, who receive it as wrapping to the packages in which the goods are imported.

9. *School bag made of sisal.* School bags and other kinds of hand bags made of this material are occasionally on sale in department stores.

10. *A bundle of Tampico hemp.* This may be obtained at the brush factories.

11. *Scrubbing brush made of Tampico hemp.* This and other kinds of brushes made of Tampico hemp may be obtained at the brush factories and stores and at the grocery store.

12. *Mexican sandals, harness, baskets, etc., made of sisal hemp.* These are not easily obtainable in this country. In some of the large cities there are dealers in Mexican curios, who could probably supply some of these articles and make arrangements to secure others. Teachers visiting the international expositions which are held from time to time should seize the opportunity to obtain samples of foreign products and the materials manufactured from them.

13. *Sap products of the century plants.* Pulque, mezcal, sugar, soap. These are difficult to obtain in this country. Remarks under number twelve apply to these also.

There should be a great number of these to illustrate every phase of the production and use of sisal and other products of the century plant family. There should be at least illustrations showing Agave plants, Agave plants in bloom, pole plants, suckers, sisal farm, cutting the leaves, hauling the leaves to the mill, extracting the fiber, baling the fiber, hauling bales to the dock, loading the ship, interior of twine mills and rope-walks, pulque farms, gathering pulque, distilling mezcal, pulque and mezcal saloons, pulque venders in the City of Mexico.

Photographs and half-tones.

It is not always possible to obtain illustrations off hand, but in time a large series can be obtained if one is on the look-out for them. Magazine articles and illustrated papers, especially trade papers devoted to the cordage industry, often contain half-tones suitable to the purpose. Photographs can be obtained thru photographers in the City of Mexico, and in the capitals of the various Mexican states. American dealers in Mexican curios, and importers of foreign photographs have facilities for obtaining selections of photographs illustrating various subjects.

1. A map of Mexico showing the usual political and physical features, and showing the principal districts in which sisal hemp, pulque and Tampico hemp are grown. An ordinary map may be used, the distributions being shown by pieces of colored paper cut to the proper size and shape and pinned to the face of the map.

Maps.

2. A map of the world showing ports from which and to which sisal and Tampico hemp are shipped. Colored strings running from pins at the exporting ports to pins at the importing ports is a good way to show this. The principal manufacturing centers using these fibers might be shown on this map.

1. Production of sisal. 2. Mexican consumption. 3. Exports of sisal as compared with other exports. 4. United States imports of sisal. 5. Number employed in the United states in manufacturing sisal. 6. Value of the material after manufacture. 7. Production and consumption of pulque and mezcal.

Table of Statistics.

These seven subjects are selected at random. They will serve to suggest many other subjects to teachers who wish to say something about the statistical side of the matter. At some stage in the school life of every child there should be some instruction given as to the proper methods of collating and using statistics.

The pupils should be taught where and how to obtain the data and how to interpret them.

Graphic charts.

There should be a set of charts showing in graphic form the items mentioned in whatever tables of statistics are used. Pupils should be required to prepare charts of various styles from the same data. An exercise of this kind brings into use their knowledge of drawing, arithmetic, mensuration, and geometry, and directs their attention to a practical side of geography in some one of its sociologic aspects. To a great extent graphic charts form the rhetoric of statistics, having an eloquence and persuasive force far beyond that of the mere figures themselves.

Explanatory labels.

Accompanying the collection should be one or more large labels, (or a note-book) telling the main facts relating to the century plants and their products. These would be best printed or typewritten if possible, otherwise neatly hand written. The label might be composed by the teacher or pupils from data obtained by reading and observation; or it might consist of a series of quotations from encyclopædias, dictionaries, and other books. For the century plants and products an excellent explanatory label could be made by simply quoting parts of the few works which are mentioned below under the heading "Literature." The labels for the individual specimens and illustrations should be as full as possible. A large card should be attached to each specimen and data when obtained and fully verified should be written in legibly and neatly. The illustrations should, of course, be mounted on cardboard (10x12 is a good size) and facts relating to them should be written on the front or back of the card. In this way the label with each specimen or illustration will in time tell a complete and interesting story.

Literature.

There should be at hand selected magazine articles, books of travel, etc., for the use of the teacher. One or two of the most interesting of these, or portions of them should be read to the class. The pupils should be asked to bring in everything they can find-relating to Mexico. The parts relating to sisal, pulque, etc., could be searched out and read. This same literature could be used over and over again while studying the geography of Mexico.

I shall not attempt to give a bibliography of the century plants but will mention a few works that are interesting:

1. The various encyclopædias.
2. The Earth and its Inhabitants, by Elisée Reclus. D. Appleton & Co., N. Y. 1891.
3. Catalog of Useful Fiber Plants, by Charles R. Dodge.
4. Notes on Some Useful Plants of Mexico, by J. N. Rose.

Three and four are bulletins of the U. S. Department of Agriculture, Washington, D. C.

5. Pamphlet issued by the McCormick Harvesting Machine Company of Chicago, describing their twine mills.
6. Poole's Index of Periodical Literature.

This may be found in all the large libraries and will serve to guide one to the magazine articles bearing upon any subject.

Lantern slides.

These should include an entire duplication of the photographs, half-tones, maps, table of statistics, explanatory labels, and graphic charts. It would be well to have also lantern slides of all the specimens. Every school house should be provided with a stereopticon.

Visits of observation.

Greenhouses, parks, gardens, museums, cordage works, brush factories, and stores should be visited. Properly conducted these visits would be one of the most important parts of the object lesson. In this matter those living in the great cities have manifest advantages over those living in the rural districts, but unfortunately most of those living in the cities fail to properly appreciate and use these advantages, and either neglect entirely to take their classes on these visits, or they make such visits without any distinct end in view. These visits should not be looked upon as outings, but as a required part of the school work. If, in studying the century plants and their importance to the Mexicans and to the rest of the world, a series of visits were made to the greenhouses, parks, and gardens to see the plants themselves, to the factories to see the fibers in the process of manufacture, to the stores to see the manufactured articles on sale, to the museums to see the various cloths, garments, etc., showing Mexican workmanship, to the library to see the books, pictures, maps, etc., relating to these plants and their products, the pupils taken on such visits would have a very valuable lesson in the proper way to investigate a subject. They would get not only the facts themselves but they would get that which is vastly more important—an insight into the methods of getting the facts.

(To be Continued.)

THE PHYSIOGRAPHY OF CALIFORNIA

(Continued from page 252.)

BY HAROLD W. FAIRBANKS

THE GREAT VALLEY

The Great Valley of California lies in the very heart of the state and is entirely enclosed by mountains save at the narrow outlet thru which its drainage passes. The valley is practically a vast plain about four hundred miles long and fifty miles wide. The San Joaquin river with its tributaries drains the southern arm and the Sacramento, the northern. These streams unite a little north of the central portion of the valley in a region of lowlands and marshes and pour their united volume thru the straits of Karquines into San Francisco bay. The two arms of the Great Valley rise very gently towards their extremities where they attain an elevation of not much over five hundred feet. Much of the lower portion of the valley lying west of a line connecting Sacramento and Stockton is flooded during the spring rise in the streams. As a result of the recent coastal submergence much of this marshy land is subject to tidal influence, the tides being felt many miles up the sluggish streams. About Martinez the flat bottomed alluvial valleys with the abruptly rising hills also support the view of a subsidence of the region about the outlet of the Great Valley.

Owing to the light grade and the large amount of material offered for transportation, some of the streams, particularly the Sacramento, flow upon channels elevated above the surrounding country. For many miles the Sacramento river is bordered by narrow banks of dry land behind which are large stretches of marsh and overflow land.

The moist winds from the ocean pass inland across the Coast Ranges, so that the eastern slopes of the latter receive much less rain than the western. The Sierra Nevada mountains being higher than the Coast Ranges, their western slope is well watered while the streams are maintained thru the summer by the melting snows. As a result of these conditions only few permanent streams enter the Great Valley from the west, and these are confined to the northern portion known as the Sacramento valley. The southwestern portion of the San Joaquin receives a very scanty rainfall.

The Great Valley occupies a structural depression of considerable geological age. The greater portion has either been near the sea level or beneath it for long periods of time while the surrounding mountains, particularly the Coast Ranges have undergone folding and faulting.

The surface of the valley is in part formed of delta deposits, of the present streams, of recent lake beds, and of the slightly eroded surface of uplifted beds of Pliocene age. The floor of the valley blends imperceptibly in many places thru the foothills into the ancient peneplain of the Sierra Nevada mountains. Upon the Coast Range side the mountains rise more abruptly, and in the San Joaquin valley in particular there are long waste slopes built up by the action of the wet weather streams.

Along the eastern edge of the central portion of the Great Valley the streams are large and have cut down slightly into the stratified sedimentary deposits of an earlier depression. Waste slopes and delta deposits are not prominent. Farther south however we find that the Kings and Kern rivers have formed large deltas which have considerably modified the surface of the valley. An examination of a relief map of California will show that the San Joaquin river lies much nearer the coast ranges than it does the Sierras. The greater watershed upon the east as well as volume of water and the large amount of waste brought from that direction have forced the river to the western side of the valley. The delta of Kings river has been extended across the valley so as to form an inclosed basin of the southern portion, from which there is overflow only in seasons of exceptional rainfall. This gave rise to Tulare lake, a large body of shallow water. With the increase of land cultivation and use of water in irrigation the lake is gradually disappearing. Kern and Buena Vista lakes are smaller bodies of water lying to the south. They are fed by Kern river chiefly and are dry during some seasons. The delta of the Kern river is dotted with cottonwood trees for miles, and altho formed of sandy material is very productive under irrigation.

The San Joaquin valley is, as a rule, destitute of trees except for fringes along the streams, but largep ortions of the Sacramento, receiving a greater rainfall are dotted with oaks. The accumulation of material in the Great Valley in recent times is enormous. Well borings in the center of the valley show that it is filled to a depth of more than one thousand feet with gravel and clay of lake or fluvatile origin. Remains of trees and land animals of Pleistocene age have been found in these deposits. The valley has either been the scene of delta accumulation above water as at present, or its surface has been occupied by a body of fresh or salt water. It is quite probable that at one time in its geological history the outlet was to the south instead of west as at present.

We find the old peneplain already referred to, particularly well developed upon the borders of the upper Sacramento valley. This plain is not now continuous with that extended over much of the Klamath mountains probably because of deformation which has occurred since. The streams which enter the Sacramento from the Klamath mountains have cut cañons thru the plain, but it is nevertheless a striking feature of the landscape.

CAJON PASS IN THE SAN BERNARDINO RANGE.

The Feather river, one of the largest tributaries of the Sacramento, has, since hydraulic mining has been carried on, built up its bed to such a degree that it is now higher than the streets of Marysville and has to be restrained by levees.

The only marked elevation in the whole of the region under discussion is found in the center of the Sacramento valley west of Marysville. It is known as the Marysville buttes. Here is a group of serrated and picturesque peaks rising about two thousand feet above the level and monotonous valley. They are known as the Marysville buttes and represent a deeply dissected volcano of late Tertiary time.

THE COAST RANGES

The presence of a continuous line of mountains along the coast of California has already been referred to. These mountains are known as the Coast Ranges or Coast Range system. As the name indicates, they are not made up of one dominant axis, but of several extending side by side and often having broad valleys between them. As we follow them northward toward the 40th parallel this composite character disappears. The broad valleys give place to cañons, and the regular mountain ranges to a broad group of rugged and irregular mountains. This latter region, lying partly in California and partly in Oregon forms the Klamath mountains. No definite limit has been established for the boundary of the Coast Ranges upon the north, and no natural one can be, unless it is upon geological grounds, for the Coast Ranges blend gradually into the higher and more rugged regions of the Klamath mountains.

Upon the south the Coast Ranges may be considered as terminating at the point where they meet the Sierra Nevada and Sierra Madre ranges. Here are the San Emedio mountains the highest point of which, Mount Pinos, reaches an elevation of over nine thousand feet. In this region also the limit placed upon the application of the term Coast Ranges is merely one of convenience. The Sierra Madre together with the Peninsula range of southern California lie farther back from the coast, and the Sierra Madre in particular is separated from it by a complex structure of lesser mountains.

Thruout the most of their length the Coast Ranges have a very regular northwest and southeast direction being nearly parallel with the coast. The slight discrepancy in direction between shore line and mountain range has given rise to the most important of the shore-line irregularities. Where a mountain range comes out to the ocean there is a more or less prominent cape, while between that and the next range there is an indentation of the coast.

Toward the southern end the Coast Ranges change their course and extend more nearly east and west. Point Arguello is the seaward termination of the Santa Ynez range and marks a change in the direction of the coast line corresponding with the east and west structure of these mountains.

The geological structure of the Coast Ranges is exceedingly complex. Repeated folding and faulting thru a long period of geological time have followed a general northwest and southeast direction. The structural conditions together with great variations in resistance to erosion of different rock formations, and the frequent movements of the land as a whole with reference to the ocean level, have given us the complicated topography of the present day.

The drainage of the great interior region of the state passes directly across the Coast Ranges thru the straits of Karquines, San Pablo and San Francisco bays to the ocean. This gap in the Coast Ranges with its tributary valleys does not appear to be of structural origin but to represent what was a depression or sag in the Coast Ranges subsequently enlarged by the concentration of the drainage lines.

MILL VALLEY AND MT. TAMALPAIS.

Thru the central Coast Ranges we cannot trace the same ancient peneplain, which we find in the northern Coast Ranges, the Klamath and Sierra Nevada mountains, unless it be in mere fragments here and there. The important structural features of the Coast Ranges date far back, but differential movement in recent geological times has been so marked as to mask or destroy topographic features which in more stable regions would have been preserved. Some of the mountain axes we know were not in existence even as late as the Pliocene period. The Berkeley hills now rising nearly two thousand feet have upon their summits folded sediments of a fresh water lake of late Pliocene age.

In the latitude of San Francisco bay the Coast Ranges appear as three well defined mountain axes. Upon the east there is the Mount Diablo range and its topographic continuation across Suisun bay in the mountains east of Napa valley. In the middle there is the northern prolongation of the Mount Hamilton range corresponding on the opposite side of the bay to the mountain ridge between Napa and Sonoma valleys. Upon the west there is the Santa Cruz range south of the Golden Gate and the range of which Mount Tamalpais is the culminating peak. The valley between these ranges opening out to San Pablo and San Francisco bays are among the most fertile and highly cultivated in the state. The Santa Clara valley penetrated by the southern arm of San Francisco bay, and the Sonoma valley extending northwest from San Pablo bay are the largest; Napa valley comes next in size. Sonoma valley, and Santa Clara with its southeast prolongation, the San Benito valley, are each nearly one hundred miles long and attain a width in places of eight to twelve miles. Their nearly level bottom lands are formed of sediments deposited in long, narrow estuaries of the ocean during the last great submergence of the coast. All about the bay are low lands sloping gently back to the surrounding hills. These are of the same nature as the valley floors except for some modification thru stream action. The bay is shoaling in many places, and since the last submergence giving rise to the present sheet of water thousands of acres have been filled in with stream or delta deposits.

The hills come down quite boldly to the straits of Karquines, a fact which would be explained by the theory of a differential movement of the mountains with reference to the floor of the Great valley.

The broad valleys of the San Francisco bay region cannot be considered other than structural in their origin, but modified and enlarged by erosion. All cannot have had the same history. The sharp contrasts between the cañons which open back into the enclosing mountains and the broad, even-floored valleys would in itself suggest that the one is new, the other old.

All the features of San Francisco bay impress one as those of a drowned area. As the land sank the sea came in thru the Golden Gate, flooding the lower portion of the great river. The character of the bays and islands, and especially the filled in valleys between Sausalito and San Rafael, illustrate particularly well this last phase of the physiographic history of this region.

Mount Diablo dominates the outlet of the Great valley. It rises to a height of 3,850 feet, and is by far the most prominent and striking feature of the Coast Ranges as one approaches them across the Great valley. The core of this mountain is made up of the older rocks of the Coast Ranges (Golden Gate formation.) Its prominence is due in part to orographic movements, and in part to the more rapid erosion of the surrounding beds.

A YOUNG CANYON IN THE SIERRAS.

The mountains enclosing Napa valley as well as a considerable portion of the Coast Ranges extending north to Clear lake, are of volcanic origin. The highest peak of this volcanic region lies northwest of Napa valley. It is known as St. Helena and attains an elevation of 4,300 feet.

As we go northwesterly from San Francisco bay, the valleys become narrower and the mountains higher. Near the coast there are heavy forests of redwood, but farther inland the mountains become less timbered while the valleys are dotted with oaks.

About one hundred miles north of San Francisco and within the heart of the Coast Ranges, lies Clear lake. It is an irregular lake with a length of about twenty-five miles and an elevation of 1,310 feet. It is the only lake of any size within the Coast Ranges. The surrounding region was the scene of protracted volcanic action during the Pliocene period. Uncle Sam, a bold and picturesque mountain of volcanic origin, overlooks the lake and rises to a height of 4,200 feet. Mineral springs of many kinds abound in this section, and at the Sulphur Bank near the eastern end of the lake, there is a most interesting example of solfataric action with deposits of sulphur and cinnabar.

The waters of Clear lake now empty thru Cache creek at its eastern end into the Sacramento river. The outlet of the lake was formerly westward thru the cañon-like depression, in which the picturesque Blue lakes lie, into a tributary of Russian river. Only a few feet rise of the waters of Clear lake, would, if the eastern outlet were stopped, again send the drainage of the lake westward directly to the ocean. The cause of the change of drainage has not been investigated. It may have been due to a tilting of the mountains or thru a lowering of the divide of Cache creek by erosion.

THE NEEDLES—Showing one type of Weathering.

North of Clear lake the Coast Ranges form practically a unit. There are but two slopes, a short one toward the east, and a long one westward to the Pacific. The crest gradually rises as we follow it northward, until in the Yallo Bally peaks it reaches a height of about 8,000 feet. The main stream draining the western slope in this section is Eel river. This stream and its tributaries exhibit a fairly well matured stage of development. The courses of the large streams are mostly subsequent, altho they still flow thru cañons, or valleys of no great width. Well formed terraces appear at many points along Eel river. At Humboldt bay, where this river comes out to the ocean, the higher mountains stand back some miles from the coast, and there intervenes a strip of level or slightly undulating country. A part of this land about the bay is of delta formation, but the most has been eroded out of a soft Pliocene formation.

Russian river exhibits an interesting feature in its lower course. From a study of Sonoma valley, with its enclosing mountains, one would naturally expect to see Russian river, which drains it, passing southeasterly into San Pablo bay. The river does not do this, however, for a little above the city of Santa Rosa, it turns southwesterly and crosses the range between the valley and the ocean thru a winding cañon. The divide separating the Sonoma valley from the bay is very low, scarcely noticeable. It is probable that the stream has either been superimposed upon the range which it crosses, thru the removal of softer materials of the valley floor, or there has been an uplift of the mountain.

The structural and topographic features of the coast ranges south of San Francisco are more complicated than north. The extension of the Mount Diablo range to the southeast, forms the real crest, or backbone of the Coast Ranges. This divide lies very near the eastern edge of these mountains the whole distance between Mount Diablo and their southern termination in the San Emedio mountains. The divide varies much in height. East of Livermore, where it is crossed by the Southern Pacific, it is only eight hundred feet high, while near the middle of the range a height of nearly five thousand feet is shown in San Carlos peak.

The Mount Hamilton range which bounds the Santa Clara valley upon the east is not structurally distinct from the Mount Diablo range. The Lick observatory stands upon Mount Hamilton, the culminating peak, at an elevation of 4,210 feet.

The Santa Cruz mountains form a broad elevated block between the Santa Clara valley and the ocean. The highest peaks of the range rise to 3,500 feet or over. Following this range southeasterly we find it gradually decreasing in height until we reach the broad and low depression separating it from the Gavilan range which is structurally a continuation of the Santa Cruz range to the southeast. During the Pleistocene submergence, there was here as at San Francisco a broad channel permitting the entrance of the ocean into the large valleys within the Coast Ranges. A divide of but little over three hundred feet separates the Santa Clara valley from the San Benito valley, while the divide between the San Benito and the ocean, discarding the Pajaro cañon, has about the same height. The San Benito drainage may at one time have gone down thru the Santa Clara valley into San Francisco bay. There are good reasons for thinking that the reverse was the case at one time, owing to the presence of a great submarine valley in the bay of Monterey and none opposite the Golden Gate. At present, however, the Pajaro river, draining the San Benito valley, has cut a narrow cañon thru the low pass separating the Santa Cruz range from the Gavilan and passes directly out to the ocean at Monterey bay.

The Gavilan range as a distinct mountain block has a length of about sixty miles when it blends with the Mount Diablo range. At its southern end are two prominent elevations known as the Chalone peak. The higher one is an ancient volcano of Tertiary age. The hardened tuffs to the north have weathered out in pinnacled forms of picturesque appearance.

NEAR THE SUMMIT OF MOUNT LOWE.

The union of the Pajaro and Salinas valleys forms the extensive lowlands about the bay of Monterey. These were formed in great part during the last deep submergence of the coast. The Salinas river, with its important tributary, the Estrella, occupies the longest and most direct valley of the Coast Ranges. Near the bay the valley is shut in between high mountains. Toward the southeast the valley narrows and the mountains become lower. In the middle and upper portion of the basin, there are broad reaches of open valley and low hills. On account of the semi-arid conditions prevailing in portions of the basin, the Salinas river, except during uncommonly wet seasons, is an insignificant one. During the summer its bed is dry in many places.

The mountain ranges which shut in the valley of the lower Salinas contrast quite strongly with each other. The Gavilan upon the east, tho attaining an elevation of three thousand feet, has only moderately steep slopes and presents the general appearance of much greater age than the Soledad hills upon the west. The latter rise also to about three thousand feet but present a steep and picturesque scarp toward the valley. The Salinas river flows close under this regular mountain wall, a fact which would indicate a recent dropping of the valley floor upon that side. Remarkably fine examples of debris fans are found along the steep slope of the mountains.

The Soledad hills form but the eastern ridge of a much higher and more important mountain block known as the Santa Lucia range. This range begins in the picturesque and rugged coast near Monterey and extends southeasterly along the ocean for about one hundred miles. It then passes inland, giving place upon the shore to another range. The Santa Lucia finally blends with the San Rafael and other mountains in eastern Santa Barbara county, and these in turn with the San Emedio mountains. The Santa Lucia is the most rugged and picturesque mountain range in the coast region of California. Its crest is from three thousand to five thousand feet high, and lying as it does only about five miles from the sea shore, the ocean slope of these mountains is exceedingly rugged and picturesque. In many places they rise with steep slopes from precipitous ocean cliffs. Upon the eastern slope of the range, the cañons which unite to form the Arroyo Seco are deep and narrow. The region is one of sharp ridges and cañons but scantily clothed with timber. The highest peak of the range is San Lucia, seven thousand feet high.

The San Luis range is that mountain block which replaces the Santa Lucia upon the coast toward the south. The seaward prolongation of this range forms a projecting headland known as Point Buchon. At the mouth of Morro bay, a few miles north of this point, stands a great rock rising bare and precipitous from the ocean to a height of nearly six hundred feet. It is known as Morro rock and is by far the most striking single feature of the coast of California. It is formed of a very resisting igneous intrusion. This rock is but one of a series of similar peaks extending inland in a southeasterly direction thru the San Luis valley.

A SCENE IN THE YOSEMITE VALLEY.

Several of them rise from the open valley to a height of twelve hundred to fourteen hundred feet in rugged and picturesque forms. They result from differential erosion in rock masses of greatly varying hardness.

A remarkable and interesting valley lies to the southeast of the extreme head of the Estrella, a tributary of the Salinas. It is known as the Carriso plain, having a length of about fifty miles and a width of ten. A scarcely noticeable divide separates the plain from the basin of the Salinas. As it is, this great stretch of country shut in on most sides by low mountains has no outlet. The sink at its centre is occupied by a salt marsh of considerable extent. The arid conditions prevailing here have kept the valley from being flooded and breaking the slight barrier between it and the Salinas. As will be seen later, the floor of this plain is continuous with an old peneplain occupying the upper Salinas valley. This is remarkable as being the only inclosed basin in the Coast Ranges.

The Cuyamas, or as it is known in its lower portion, the Santa Maria, is one of the most interesting rivers of the Coast Ranges. It rises far to the southeast in the San Emedio mountains and flowing northwesterly for many miles between the Mount Diablo, or rather the southern extension of that range, and the San Rafael mountains finally turns abruptly southwesterly, leaving the broad Cuyamas valley, and cañons directly across the Santa Lucia range to the ocean. The Cuyamas valley was probably formed as a consequence of fault movements which left it without an outlet. A lake resulted, and in the overflow of the lake originated the stream which cut the present cañon.

The extreme southeastern portion of the Coast Ranges form a rugged and complex group of mountains known as the San Rafael mountains. They are largely covered with dense brush, altho there is some timber where the conditions are favorable. The cañons are deep and show but little or no bottom land. From this region the Sisquoc and Santa Ynez rivers flow westerly, the Ojai and Sespe southerly. Zaca lake is a small but well known body of water in the western part of the range. It occupies the valley of a small stream which had graded its valley to correspond with the conditions existing when the coast was depressed about eight hundred feet.

The Santa Ynez is a regular and continuous range which borders the coast from Point Arguello easterly. Upon the north is the broad valley of the Santa Ynez river, while upon the south a narrow strip of land separates it from the ocean. This strip of land is, however, fertile and highly cultivated. The city of Santa Barbara is situated upon it.

From the foregoing description it may be judged that the larger valleys of the Coast Ranges have not developed contemporaneously with the cañons in the mountains which enclose them. The cañons correspond in their stage of development fairly well to those in the Klamath mountains and the Sierra Nevada, but the valleys have had a longer history. It is a complex history to be sure, but structural conditions rather than erosion have determined in most cases the position and character of the valleys.

As illustrating how structural conditions have affected the topography, there might be mentioned a line of narrow valleys extending from the northern portion of the Sierra Madre mountains across the San Emedio, and northwest thru the Coast Ranges toward San Francisco. These valleys have been eroded as a result of earthquake movements in recent times. In fact the formation of fissures and low ridges resulted along this line from an earthquake not more than forty years ago. The line of movement or fissure zone is in places half a mile wide, and many distinct ridges and depressions can be counted. Springs issue from this zone of broken rock and erosion is proportionately rapid.

PASADENA AND THE SIERRA MADRE.

As has already been stated the peneplain which was developed thru Tertiary time upon the slopes of the Sierra Nevada mountains, the Klamath mountains, and probably also in southern California, cannot be traced continuously thru the Coast Ranges owing to the strong deformation experienced in this region in late Tertiary time, as well as to the fact that during long intervals in the

Tertiary the central and southern portions of the Coast Ranges were submerged beneath the sea.

The fact that the main valleys of the Coast Ranges exhibit an apparently advanced phase of development, and that the main streams are generally subsequent, does not, then, indicate that this region has been elevated longer than the Sierra Nevadas.

The peneplain of the Klamath mountains can be traced continuously southward nearly to San Francisco bay, descending slowly from a height of three thousand to four thousand feet in the former region to about 1,500 feet near its southern limit. The planation was not complete for scattered peaks rise above this plain. During the development of the peneplain the most of the streams had adjusted themselves to the structural conditions. With the uplift they retained these courses so that we have now well adjusted streams where we might expect consequent ones.

With the close of the Pliocene, folding and faulting inaugurated new conditions thru much of the Coast Range area. In the northern portion the old plain was distorted but not broken. Many of the flat-topped crests of mountain ranges south of San Francisco bay probably date from the late Tertiary. One of the most important of these is to be observed upon the Santa Lucia range. In the middle portion of the range there is an area fully ten miles across, and many miles long, which, altho now deeply dissected, yet presents an almost level sky line at an elevation of about three thousand feet. There are many other areas of similar character scattered thru the central and southern Coast Ranges.

Following the post-Tertiary disturbances, and during the interval of the early Pleistocene submergence, when the coast was one thousand to fifteen hundred feet below the present level, conditions must have been favorable in places for the extension of the Tertiary peneplain, and for the evolving of partial plains of erosion upon the newly formed mountains as in the case of the Berkeley hills where there are strong indications of peneplanation at an elevation of about 1,500 feet.

As the coast began to rise from the Pleistocene submergence it remained long at a height above the present level of between 750 to 1,000 feet. Extensive plains corresponding to this height were formed in the valley of the Salinas, north of the Santa Ynez valley and in other places. In the Salinas valley, owing to the wide distribution of soft rocks, the erosion plain was particularly extensive. It was fully 150 miles long reaching far southeast into the Carisa plains and across the crest of the Coast Ranges into the Great valley.

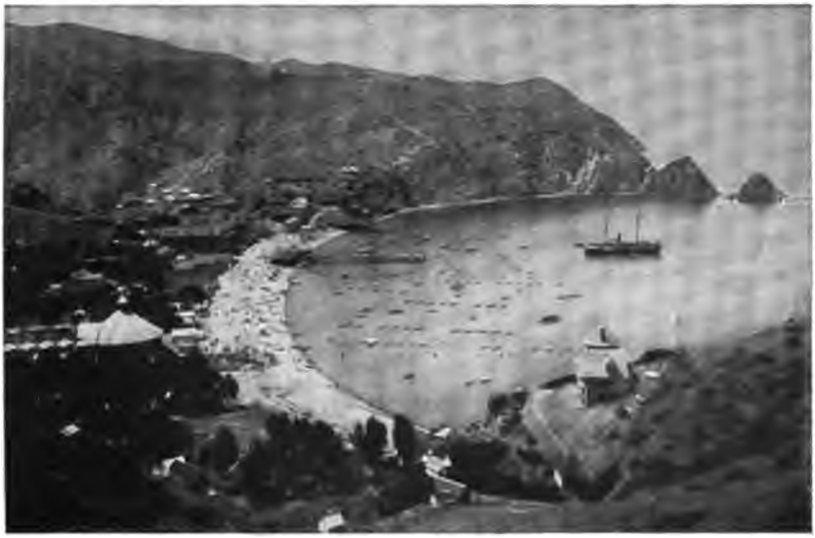
Since the elevation of the coast to its present height, broad valleys have been eroded in this plain and a new erosion plain is in process of formation. There are then to be recognized thru the central and southern Coast Ranges: (1) a broken and deformed plain of Tertiary age, remaining only as fragments here and there; (2) an extensive one of Pleistocene age but slightly deformed; and (3) a recent one being evolved out of the last. In the northern Coast Ranges, the Tertiary plain, tho deeply eroded and deformed, is continuous.

THE KLAMATH MOUNTAINS

The use of the term Klamath mountains has been limited to that portion of the Coast Ranges lying north of the south fork of the Trinity river and extending northwest to the ocean, and into Oregon. These mountains are limited upon the east by the line of contact between the older crystaline rocks and the lavas of the Cascade range. On the boundary between California and Oregon the Klamath mountains join the Cascade range in an unbroken ridge, but both north and south of this point broad valleys separate the two mountain ranges. In California the eastern border of the Klamath mountains extends south along the western edge of Shasta valley, then easterly around the southern base of Mount Shasta, and then bending south, follows down Pitt river to the Sacramento. Along much of this line the contrast in topography between the volcanic plains and the steep slopes of the Klamath mountains, is very marked.

Different portions of the Klamath mountains are known under different names. The Siskiyou range forms a group partly in California and partly in Oregon. The Scott and Salmon mountains lie to the south and include the highest peaks of the whole group, many rising from seven thousand to nearly ten thousand feet. The geological structure of the region is not as regular as in the Coast Ranges to the south, and as a consequence the mountains and valleys have no definite arrangement. The streams flow in deep, and generally narrow cañons, except in a few cases where basins inclosing softer beds than those forming the main body of the mountains have given rise to valleys of considerable size. Among these are Scott's valley, Hay Fork valley, and the valley about Weaverville.

Among the larger streams are the Klamath, Trinity, and Sacramento rivers. The Klamath river rises in the Klamath lake basin east of the Cascade range in Oregon. It flows southwesterly into California, and, after crossing the depressed portion of the Cascade range, pursues a tortuous course in a deep cañon across the Klamath mountains to the ocean. The mountains traversed rise to a height of six thousand or seven thousand feet, and the question naturally arises why the river should have cut across these mountains rather than have turned southerly thru Shasta valley where a low divide of only 3,400 feet elevation above the sea separates it from the basin of the Sacramento river. In this case the most reasonable explanation seems to be that of a gradual rise of the Klamath mountian region after the river had acquired its present course.



AVALON, SANTA CATALINA ISLAND.—A harbor made by the partial flooding ot a valley of erosion. Result of last subsidence of the coast.

The source of the Sacramento river is in large springs issuing from the lava at the southwest base of Mount Shasta. The stream flows southerly and, after leaving the lava, crosses a spur of the Klamath mountains before reaching the Sacramento valley. Its course for many miles is thru a picturesque cañon. The cañon antedates the latest of the lava streams from Shasta, for one of them flowed down thru it for fifty miles. The river has cut thru the lava in most places and is now deepening its channel again. Among the picturesque features of the upper Sacramento cañon are the Castle Crags, bare and castle-like pinnacles of granite.

The Trinity river drains the southern portion of the Klamath mountains. The basin of this river is separated from the Sacramento valley by Bully Choop mountains, while upon the north are the Salmon and Scott mountains.

The higer portions of the Klamath mountains, particularly the Salmon range, were glaciated during the Glacial period. The glaciers were more local than those in the Sierra Nevada mountains and did not descend below five thousand feet. The higher mountain valleys contain numerous little lakes, which with the moraines and polished rock surfaces are characteristic of glaciated areas.

Viewing the Klamath mountains as a whole, we find that they have many physiographic characters in common with the Sierra Nevada mountains. There is the same absence of isolated peaks rising much above the elevated ridges, and the same deep cañons carved out by erosion. Geologically they also have much in common.

THE SIERRA MADRE AND PENINSULA RANGES

Under this head will be included all that part of California lying south of the San Emedio mountains and west of the Great Basin area. The broad and high range of mountains extending south of east from the San Emedio region, forms the watershed between the fertile valleys of southern California and the Mojave desert. This mountain block is known at various points under different names. The designation Francisquita mountains is given to that portion lying south of Antelope valley (western arm of the Mojave desert) and west of Soledad pass. East of this pass the range broadens and becomes much higher, reaching an elevation of nine thousand feet in San Antonio peak. This portion is known as the San Gabriel range.

At Cajon pass the range is again depressed sufficiently to permit of its being crossed by a railroad. Beyond the pass to the east rises the still more lofty and rugged San Bernardino range culminating in Grayback, over eleven thousand feet high. To the east the range now becomes lower and forms the low divide between the Mojave and Colorado deserts.

The Sierra Madre range, as a whole, was elevated near the close of the Tertiary period, probably thru the combined influence of folding and faulting. The southern front of the range is particularly bold and imposing rising as it does from extensive valleys and waste slopes elevated less than one thousand feet above the sea. The mountains are deeply cut by sharp V-shaped cañons in which are insignificant streams during the dry season. After heavy storms each carries a muddy torrent, which, spreading out at the mouth of its cañon, contributes its load to the building up of the waste slope.

But one stream of any consequence, the Mojave river, drains the northern side of the San Bernardino range, and it is soon lost in the sands of the desert. Upon the southern side the San Gabriel and Santa Ana rivers are the most important, but even these carry but little surface water to the ocean. The most of it is used in irrigation.

The Santa Clara river drains the northern portion of the area under discussion. Its tributaries head in the San Emedio, Francisquita, and San Gabriel mountains. In the middle and upper portions of this basin the rainfall is light, and except after periods of heavy rain but little water flows upon the surface of the river bed. The valley of the Santa Clara expands to a width of twelve or more miles near the ocean, and for fifty miles back from the coast is highly cultivated. Mounts Pinos, Alamo, and Frazier upon the northern edge of this basin are the loftiest peaks of the San Emedio range. The two latter peaks in particular have nearly flat summits of considerable extent which appear to be remnants of an ancient peneplain. The Tertiary and Pleistocene deposits high up on the flanks of these mountains testify to very marked elevation in recent geological times.

The valley of the Santa Clara river seems to have originated in a structural depression formed thru faulting. The San Fernando range bordering this valley upon the south and eighteen hundred to three thousand feet high gives evidence in its bold scarp facing the valley, and gentle slope to the south, of being a raised and tilted block. The valley of the Santa Clara river has like most of the other large streams had its bed graded up in adjustment to the present conditions.

Extending east and west along the north side of Santa Monica bay, and reaching eastward to Los Angeles, is another mountain ridge known as the Santa Monica range. Its highest peaks reach an elevation of nearly three thousand feet. The range is formed largely of volcanic rocks. Structurally it appears to be continuous with the islands to the west lying off Santa Barbara channel.

An irregular line of low mountains stretches along near the southern base of the San Gabriel range and is separated from it by a waste filled valley. In the eastern end of the San Fernando valley this elevation is known as the Verdugo mountains. Farther east are the San Rafael hills. Between Los Angeles and Pasadena these hills are much eroded, but beyond the San Gabriel river they rise again to form the Puente hills. Tracing them farther still, they are found to increase in height, forming the steep and high Santa Ana range whose eastern front is a great fault scarp of recent geological origin. The highest peak of the range has an elevation of 5,600 feet.

Between the San Gabriel river and San Fernando the streams issuing from the San Gabriel range have cut across this line of hills and mountains, and in many places have nearly obliterated them. The waste slopes sweep across them in even grade.

The plain stretching from Los Angeles south and west to the coast formed the floor of a broad bay during the last extensive submergence of this region. It has been but slightly modified by erosion.

The Santa Ana is the largest stream of southern California. Rising in the San Bernardino range it flows westward past San Bernardino and Riverside thru a region of low relief, and then cañons thru the northern end of the Santa Ana range. It emerges from the cañon upon a broad flood plain which extends to the ocean. The river was probably either superimposed upon the Santa Ana range because of an original deposit of soft sediments filling the basin thru its middle course, or it cut the cañon as the range was slowly elevated across its course.

The old topography in the region about Riverside is most interesting. The graded condition of the streams, the low hills of granite and ancient crystalline schists afford us a picture of what nearly the whole of southern California might have been if it were not for the faulting which gave rise to the rugged ranges of the region. If it were not for these high mountains arid conditions would prevail and there would be another Mojave desert.

This area of ancient topographic forms stretches south from Riverside for many miles and also west to the Puente hills. It presents the most striking contrast to the bold scarps of the Santa Ana, San Bernardino, and San Jacinto ranges.

South of the San Bernardino range, and on the south side of the low pass leading east to the Colorado desert, rises the rugged peak of San Jacinto to a height of about eleven thousand feet, twin brother to Mount San Bernardino.

Mount San Jacinto may be termed the northern end of the Peninsula range, that continuous chain of mountains stretching from this point south for nearly one thousand miles thru the peninsula of lower California. This range rises as a general thing very abrubtly from the desert and gulf at its eastern base, and in position and structure might be considered a worthy continuation of the Sierra Nevada mountains. The lower portion of the scarp of the range near the Mexican line is particularly bold. Here recent faulting has raised the mountains about one thousand feet. Upon the slope of Carrizo mountain mollusc borings still remain upon the surface of the limestone at an elevation of twelve hundred feet.

The western portion of Mount San Jacinto, overlooking the broad reaches of the valley of the same name, is a bold fault scarp. San Jacinto river flowing for some distance at the base of this scarp turns abruptly southwest, and crossing the region of old topography already described, empties in seasons of exceptionally wet weather into Lake Elsinore, the largest lake of southern California. This lake lies at the eastern base of the southern continuation of the Santa Ana fault scarp, and occasionally overflows northwesterly down the Temescal valley to the Santa Ana river.

Following the fault scarp from Elsinore for thirty miles in a southeasterly direction we come to Temecula creek, a stream of considerable size rising to the south of San Jacinto. This stream instead of flowing northwest along the base of the scarp as we should naturally expect it to do, has instead cut a cañon directly across the scarp and pursues a fairly direct course to the ocean. Here as in many other cases there are two hypotheses to choose from to account for the course of the stream. Either the mountain scarp has been slowly raised across its course or the valley in the depressed block to the east of the fault was filled with pleistocene deposits to a level with the rim of the scarp at the time the drainage was established. Which explanation is the correct one has not yet been determined.

The cañon which the stream has cut is narrow and quite picturesque. Standing at the top of the present steep walled cañon we appear to be in the centre of a broad valley of older topographic forms, a valley eroded and fairly matured before the last uplift.

South of Temecula the fault scarp disappears altho Smiths mountain which appears to be an uplifted block may be related to the same line of disturbance. Toward the southern boundary of the state the Peninsula range becomes more simple. Back of San Diego the crest of the range is nearly as far from the fault line at its eastern base as from the western. The features of an ancient baselevel are particularly noticeable upon the crests of the mountains and ridges. The summit of Smiths mountain as well as that of the Laguna mountains are fine examples of flat topped. Viewed from a point east of Fallbrook the western slope of the mountains forms a nearly even sky line gently dipping towards the coast. The present cañons have been eroded in this ancient plain, and in many cases they have widened to extensive valleys. The main streams are completely graded, flowing over a sand floor. Their beds are dry during a great part of the year but water can be obtained in abundance by sinking thru the sand.

The extensive mesa extending from San Diego to ocean side is an old sea floor. Except for the steep walled cañons cut across it the surface has been but slightly modified since the uplift. One can trace in places the successive lines of sand dunes formed as the coast rose. San Diego bay has probably been formed thru the drowning of a river valley in connection with the action of ocean waves and currents.

COAST FEATURES

The fact has already been mentioned that along the whole length of the California coast the topography resulting from subaerial erosion has been modified by wave action and sedimentation incident to depressions of the coastal area. The lower portions of the stream valleys once excavated deeper than they now appear were partly filled with sediments when the ocean level was 1000 to 1500 feet higher. At the next period of elevation stream erosion was again active. Now the valleys are again being silted up to sea level as a consequence of submergence.

Nearly every stream along the whole length of the coast has either a tidal lagoon at its mouth, the tide entering from a few hundred yards to a number of miles, or an extensive alluvial plain. Those streams like the Klamath river, containing a large volume of water the year around, maintain an open channel to the sea, the tide flowing in and out. The entrance to San Francisco bay is preserved not so much thru the volume of the river which finds its outlet here as thru the vast amount of tidal water pouring thru the Golden Gate.

Those streams like the Salinas which flow a considerable amount of water for only a portion of the year, and whose channels are deeply filled with detrital material do not show the effects of subsidence as distinctly because of the filling in of their estuaries. Along the southern coast there are many streams of this character. There are other small streams flowing only during wet weather and which carry but a small amount of the detrital material. During the summer the waves and ocean currents block the outlets of these and the enclosed lagoons on drying leave a surface whitened with more or less salt. These conditions are beautifully shown along the coast of San Diego county where the cañons of many small streams have been flooded by subsidence.

Numerous wave-cut terraces of varying width are to be observed at favorable points along the whole coast of California. These range from ten feet to fifteen hundred feet in elevation.

The great mesa north of San Diego is a wave cut plain. Its upper limit has an elevation of about eight hundred feet.

San Pedro hill, forming a prominent feature of the coast opposite Los Angeles, is finely terraced up to an elevation of twelve hundred feet. San Clemente island, which, like the other islands, seems to have moved in the main with the mainland, is terraced up to nearly fifteen hundred feet.

At Point Sal, in northwestern Santa Barbara county, there is a broad terrace at one thousand feet. Upon the seaward slopes of San Luis range there are many terraces, some of them remarkably perfect, they range in height from ten to 750 feet. Upon the slopes of the Santa Lucia range they appear at heights of 750 to one thousand feet. Very fine terraces also appear along the slopes of the Santa Cruz range. North of the mouth of Russian river they are recognizable as high as fifteen hundred feet. The upper one forms a bench against the old peneplain so distinctly shown in that region.

As the land rose permitting the formation of these terraces, there was a prolonged stop at an elevation varying from 750 to one thousand feet; the difference between these figures possibly indicating the amount of differential movement since. The breadth of this terrace and its correspondence in height to the broad peneplain of Pleistocene age which is very prominent thru portions of the Coast Ranges marks this as an important stage.

As the coast rose the rivers also formed terraces. Below Bradley upon the Salinas river six terraces can be seen.

Along nearly the whole length of the state except where the mountains rise directly from the ocean cliffs there is a coastal plain. This varies in width from a fourth of a mile to several miles, and in height from sixty to two hundred feet. Along portions of the Mendocino coast where this plain is broad and furnishes a large part of the best land in the county, much of it attains a height of four hundred feet.

The coast of California is bordered by a submarine plateau sharply marked off from the deep waters of the open Pacific. This plateau is a part of the continental mass and has at various times in its history been wholly or in part raised above the water. The present islands rise from the surface of this plateau, and represent peaks of mountain ranges structurally related to those upon the adjoining mainland.

The submarine plateau is quite narrow along the coast of northern California. From point Arena southward it slowly widens sweeping just outside of the Farrallon islands, twenty miles off the Golden Gate. The surface of the plateau generally slopes very gradually out to the one hundred fathom curve when it takes on a much steeper descent to the deeper portions of the plateau or to the abyssal depths of the Pacific.

The plateau narrows opposite Monterey bay, and along the high Santa Lucia range the one hundred fathom curve is only 4.6 miles from shore. Farther south it widens, sweeping out side of the channel islands, and finally attaining a width of 150 miles. The surface of the broad portion of the plateau is far from being uniform. Some of the islands rise over two thousand feet above the sea level, and in places the depth of the water at their bases is two thousand to three thousand feet. An elevation of less than one thousand feet would connect the Channel islands (those lying off Santa Barbara) with the mainland. Such an elevation existed during the early Pleistocene, for remains of the mastodon and other mammals are found upon one of them. The water about San Clemente and Santa Catalina is much deeper.

Crossing this marginal plateau at various points are submarine valleys which from their position and general character are believed to have been formed by subærial erosion. Many of the most prominent valleys lie opposite the mouths of the present land valleys, some are not thus situated. The greatest of the submarine valleys is that occupying the bay of Monterey. It extends westerly from a point near the mouth of the Pajaro and Salinas rivers and down across the plateau to the abyssal depths of the Pacific. It reaches so close to the shore as to have influenced the location of a wharf. It has been thought that because of the absence of any submarine valley opposite the Golden Gate the drainage of the Great valley once entered the ocean thru the valley in Monterey bay.

Many important and interesting facts connected with the physiographic history of California yet remain to be studied. Enough has been said however to give some conception of the varied features of the state, and to show the richness of the geographic material at hand for our schools.

THE NILE COUNTRY

(Continued from page 270.)

BY MARY E. ANDREWS

From the fern-draped cliffs of the western shore of Victoria stretches a magnificent forest, where Africa's most noble trees are to be found. There is the gigantic sycamore, and the slender-stemmed palm in many varieties, the plantain, gum, acacia, thorn, euphorbia, and many more, while slender lianes twist themselves from tree to tree. Then follows an open, rolling country, which rises into higher and higher outlines, until the hills are heaved up mountain high along the rim of the Great Rift valley. Suddenly they are cleft in twain, and we look down the precipitous declivity upon the waters of Lake Albert. "Like a sea of quicksilver" it appeared to Baker when, first of Europeans, he looked upon its face.

Farther south the mountains tower to yet sublimer heights, until at last the dominating mass of Ruwenzori, the Cloud King, sends its snow-born streams to feed Lake Albert Edward, and, thru the Kagera and the Katonga, Victoria Nyanza on the plateau at its feet. This mountain mass is from seventy to eighty miles long, and its lofty summits are crowned with perpetual diadems of snow. Well do the natives call it the Cloud King; for it lifts its head into the eternal snows, 16500 feet above the sea; and it wraps its mist mantle so closely about it that its highest peaks are hid from curious eyes more than half the year. Sir Samuel Baker reached a point on the Albert Nyanza from which the Ruwenzori range should have been plainly seen; but the jealous monarch hid himself behind his veil of cloud, and the great range was blotted out from view. Others also looked and saw nothing save the lower heights topped by banks of cloud and mist.

And herein we have the explanation of a mystery; for Ruwenzori is undoubtedly the Jebel Kumr, the Montes Lunae of mediæval geographers. So long did the Cloud King wrap the concealing mists about him that his very existence was forgotten, or disbelieved, by the modern geographer. The splendid panorama of forested slopes and snow-crowned summits was revealed at last to Stanley's eyes, in May, 1888. "The upper part of the range," he writes, "now divided distinctly into many square-browed peaks, seemed poised aloft in a void of surprising clearness, domed by a dark blue heaven as clear and spotless as crystal; and a broad zone of milk-white mist, enfolding in the middle, caused it to resemble a spectral mountain isle sailing in mid air— to realize a dream of an Isle of the Blest."

Another classical mystery finds its solution amid this maze of mountains; for somewhere in their forest depths native report places the Batwa, one of those isolated tribes of a race of dwarfs scattered across equatorial Africa, who seem to represent a people once widely spread over the continent, now approaching extinction.

Schweinfurth has given a lively description of the pygmies of the Akka tribe: of their agility in attacking the elephant by crawling under the huge creature, striking upwards, and then dexterously springing out of harm's way; of the lively expression of their faces; the twitching of the eyebrows; the animated and expressive gestures. With their poisoned spears and their marvelous agility they are no mean foes.

The discovery of these little people by Schweinfurth and Stanley explained the many allusions to a race of dwarfs dwelling in remote parts of Africa found in Greek literature. As the word implies, the pygmies of the ancient Greeks were conceived to be no larger than the fist; and the allusions to them in the Iliad, in the works of Herodotus, of Aristotle, and of many Greek poets, were set down as classical fables until the nineteenth century explorers, penetrating the heart of Africa, discovered that here, too, the ancients knew whereof they spoke; and that in the tales of the old Greek poets we have but the truth minimized, so to speak.

In the fringe of silver streams that fall from Ruwenzori's snow-capped heights, the waters of the Nile system are found at their greatest altitude above the sea. And at the foot of the Cloud King, in the depths of the Great Rift valley, lie the beautiful pale blue waters of Muta Nzige, or Albert Edward lake, which flow out thru Semliki river, and after traversing a noble forest enter the waters of Lake

Albert. The fiord-like scenery of the Rift valley lakes is shown in all its wild picturesque beauty along the shores of Muta Nzige, the Grasshopper sea, as the natives call Lake Albert, whose splintered crags of granite, gneiss, and dark red porphyry rise almost vertically fifteen hundred feet above its face, isolated peaks reaching a height of five thousand, and even ten thousand feet. To the northwest of Lake Albert, on the table land above, rises the Blue Mountain range, which forms the water parting between this part of the Nile and the Congo.

Tho the Shimiyu may be the longest tributary of Lake Victoria, the Kagera, or Alexandra Nile, is by far the most copious. Its source is not far from the margin of that part of the Rift valley in which lie Lakes Albert and Albert Edward, and it is fed by many streams from the lofty Ruwenzori range. The country thru which it flows is similar to that of the Shimiyu. Wave after wave, the low, grass covered ridges roll on to the foot of the western mountains. Few trees are to be seen, but banana groves surround the villages of the dome-shaped huts so characteristic of central Africa. Flowing on in ever increasing volume, the Kagera spreads out from time to time, now into a lake of considerable size, and again into papyrus-covered swamps. It reaches the southwest corner of the lake as a deep, powerful stream, which the natives call "The mother of the river at Jinja," the native name for Ripon Falls.

Such is the country in which we find the remotest sources of the River of Egypt.

From its lofty elevation of four thousand feet, the Victoria Nyanza pours its waters over the low ledge of Ripon Falls, and enters the Somerset or Victoria Nile. To reach the waters of Lake Albert, the river must make a descent of fourteen hundred feet or more; hence the stream is swift thruout, foaming along its rapid course between high cliffs covered with bananas and palms. About midway in its course it widens out into a lake some fifty miles broad, to which the name of Lake Ibrahim has been given; and about half way between this and Lake Albert the swift waters leap down a perpendicular wall of rock about five feet, forming Karuma falls. From here on it dashes from gorge to gorge in a succession of wild rapids, where the water is beaten into a fine spray that is carried to shore and precipitated upon the rich vegetation of the forest. This precipitous course of the stream terminates at Murchison falls, where it drops over a ledge of rock some 120 feet high, between cliffs of black basalt.

This is by far the greatest waterfall of the Nile, and it seems to be the final plunge in the rapid succession of leaps from gneiss plateau to Rift valley level; for almost immediately the stream becomes very sluggish, and soon joins the lower lake as dead water, by an entrance all but hidden by papyrus thickets. In the wilderness beyond these, Gordon saw a herd of elephants tossing bundles of long grass into their mouths with their trunks, their hugh ears flapping about their heads like sails.

Once arrived upon the surface of Lake Albert, we have left behind and far above us the high plateau on which lies Lake Victoria; and we now find ourselves in the midst of the fiord-like scenery of the valley, with its splintered and faulted rocks, its stupendous heights and yawning chasms everywhere testifying to the mighty forces that gave them birth.

From Lake Albert, almost 2500 feet above the sea, to Lado, about fifteen hundred feet, the Nile, or Bahr-el-Gebel as the natives call it, still traversing the highland region, flows thru a picturesque gorge worn by its waters. Gordon, who first ascended this part of the river while Governor General of the Sudan, 1874-79, found it navigable except for the two and one-half miles over which the Fola rapids extend. Here the river suddenly contracts as it saws its way thru the Latook mountain barrier, forming what may properly be called the eighth cataract of the Nile. It is the only one not navigable from Lake Albert to the sea, the seventh, situated a few miles below, and the six below Khartum, all being passable for boats in time of high water.

The Fola rapids are close by the juncture of the Asna river, the only Nile tributary, except those entering the equatorial lakes, whose basin is wholly within the equatorial highland region. It receives the drainage of the west slope of the Madi mountains, and the entire drainage of the Madi and Shooa countries, tries, together with that of countries to the west of Shooa. It is a tremendous mountain torrent, carrying a vast volume of water to the Nile.

Baker gives an enthusiastic description of the Asua country: of the castellated appearance of the granite mountains that rise nearly four thousand feet above the main stream; of the beautiful park-like character of the scenery, magnificent forest alternating with vast, rolling prairie where abundant crops of sesame are cultivated, and where fine herds of cattle find pasturage.

The inhabitants of this land, "flowing with milk and honey," as Baker characterizes it, the Shuli, are a peaceful, agricultural people, who show great respect to their women. They wear a scant covering of skins, load their wrists, ankles and necks with iron rings, and build up their hair into elaborate coiffures several stories high, decked with strings of beads, rings, feathers—anything that may serve as ornament. Opposite them, on the west bank of the Nile, are the Luri, and to the north are the Madi, in whose country is Dufile, 3° 40′ N., 32° E., destined to be an important strategical point, owing to its commanding position.

North of the Madi, and occupying the country around Lado, are the Bari, remarkable for their fine physique, their haughty bearing, and their great bravery. Women are allowed to wear the loin cloth, but the men scorn clothing as effeminate. "He came in full dress—a necklace," wrote Gordon of the visit of a Bari chief. Roman Catholic missionaries have worked among these bravest of the Nilitic tribes but with little effect, the slave trade, so long the scourge of central Africa, being inimical to the spread of Christianity among them.

At Gondokoro, 4° 54′ N., 31° 28′ E., in the Bari country, Sir Samuel Baker and his wife, exploring the Nile from Khartum upward, in 1866, met with Speke and Grant, who had crossed over from the Zanzibar coast to explore Lake Victoria. It was one of those unexpected meetings for which the history of African exploration is noted. Gondokoro afterwards became the headquarters of Baker while Governor General of the Sudan, but was abandoned by Gordon for the more desirable location of Lado, six miles below, on the west bank of the river.

The country near Lado is described as beautiful and park-like, dotted here and there with great, sugar-loaf shaped trees, in the shade of which are the villages of the Bari, neat circular straw huts, with well filled corn bins raised on stakes, to keep out the rats and white ants.

At Lado the Nile emerges from the highland region to wander thru the interminable marshes of the lower plain, Bahr-el-Gebel no longer. Here, then, we may pause and look back over the first stage in its journey to the sea. We find it to be a magnificent plateau, where abundant rains feed a rich tropical vegetation, and high altitude tempers the heat of the tropics, making the climate healthful. It is a region eminently fitted for the development of a high civilization; and when one looks on the pictures of savage brutality drawn by the explorers of the last fifty years, one does not feel disposed to cavil at the European partition which makes possible the development of Christian civilization.

The Nile is called Bahr-el-Gebel as far as the entrance of the Gazelle; but the mountainous character of its scenery ceases at Lado, where Gebel Lado and the Madi mountains south of Gondokoro stand like sentinels at the gateway of the highland region.

They have not yet disappeared below the southern horizon when the river slows up and winds in endless convolutions over the level plain, widening out frequently into ill-defined marsh and lake, or splitting up into many passages that are soon lost among floating islands of vegetation. It would be difficult to exaggerate the wretchedness of the country. The few inhabitants, Nuers, are a miserable, fever-stricken people, their straw huts reached only by wading thru the swamp. "It is a heart-breaking country," says Baker, "without a single redeeming feature." With their broad flat feet, long spindling legs, small heads and long necks, the Nuers, like the Dinka and the Shilluks, have been compared to flamingoes; and they have a habit of standing a long time on one leg, which adds to their comical likeness to their feathered neighbors.

This is the region of the "sudd," or "sett," or grass barriers of the Nile, which extends from about 7° N., to Fashoda, 10° N. Many plants are concerned in the formation of these curious floating islands of the Nile. Prominent among them is Pistia Stratiotes, a little plant with a top like a lettuce head and a root five feet in water. The decay of the Azolla, a water fern, and of other aquatic plants, forms a ropy, gelatinous mass that binds the roots of the Pistia, together with drift of various sorts, into a compact mass. Grasses and ferns take root on the floating raft, with less humble plants as well. Ambatch, a leguminous plant eighteen to twenty inches high, with star-shaped leaves and golden yellow flowers like those of the broom, is peculiarly adapted for life upon these floating islands. Its wood is the lightest known; so light, indeed, that one man can carry three canoes made of Ambatch, each one capable of holding three men. Papyrus, too, is a dweller upon the sudd, and even trees are sometimes met with.

The Nile rises and floats out these masses of vegetation; they come down to a curve and stop there; more islands float down, until the river is blocked for miles; under this floating bridge the water flows on.

Amid the floating islands of tropical vegetation that block this part of the Nile, we are again on classic ground; for history records that Nero once sent a body of centurions to explore the source of the Nile, and that they returned, unsuccessful, telling stories of cataracts and impassable marshes. Undoubtedly it was the swampy barriers of the sudd region that baffled the Roman explorers. The failure of Nero's imperial soldiers became the triumph of the English explorer, however, when, in 1861, Sir Samuel Baker and his young wife, with indomitable perseverance, cut their way, first of all Europeans, thru the sudd of the Nile.

In 1873 the British government sent three companies and two steamers to cut a passage thru the Nile sudd. Large blocks of vegetation were cut away, and the water burst the remaining barriers with terrific force, carrying multitudes of fishes, with crocodiles, rhinoceroses and hippopotami, like chips, pellmell down the river. The channel thus opened reduced the time between Khartum and Gondokoro from fourteen months, the time it took Baker to force a passage, to three weeks. What the prolific vegetation of the tropics can do once, however, it can repeat; and the way must be frequently cleared. Even a brisk wind is sometimes sufficient to impede navigation by the accumulation of floating islands.

About 170 miles above the entrance of Bahr-el-Ghazal, the Nile sends off a side channel, Bahr-el-Zeraf, or the Giraffe river, which rejoins the main stream a short distance below the Gazelle. The entrance of the latter stream, in the heart of the sudd region, is marked by Lake No, the shrunken remnant of a vast sheet of water that once occupied this region, covering a territory as great as that now under the waters of Lake Victoria.

With the exception of two or three inconsiderable streams and wadies, Bahr-el-Ghazal, or the Gazelle river, is the one Nile tributary from the west between Lake Albert and the sea; and it is by far the most important river system connected with the Nile.

The highland rim of the Gazelle basin is a spur of the Galla Abyssinian highland. Extending northwest from the region of the Great Lakes, it curves around to the east and southeast, separating the Congo and Tchad systems from the Nile. It is much lower than the grand plateau from which it springs, the height of Munza's great hall, just over the divide, on the Congo slope, being 2707 feet; but it shows the characteristic scenery of the higher region. Flat-topped, fortress-like hills of granite, and rounded mounds of gneiss rise here and there above the dewy steppes; magnificent forests occur at frequent intervals; and the abrupt descent from highland rim to lower plain is marked by falls and rapids.

Lakes, which are so important in other parts of the Nile system, seem to be wanting in the basin of the Gazelle; but the swamps of the sudd region, which extend far up the Gazelle and its tributaries, form a catchment basin from which the Gazelle waters, with those of Bahr-el-Gebel, are fed to the lower streams.

The country of the Gazelle and its more southerly tributaries, the Dyoor, the Wow, and the Tonj, has been made known to us chiefly by Schweinfurth, who, in 1871, made an extensive trip thru the region with a company of ivory traders. He has given us a minute description of the Niam Niam, who inhabit the watershed between the Dyoor, tributary to the Gazelle, and the Walle, tributary to the Congo.

The name Niam Niam means "great eaters,"and it is well chosen. They are a fierce tribe of cannibals, and human flesh seems to be the most important article of their diet. Their scant clothing has yet a certain picturesqueness, and the skins which compose the chief garment are evidently selected for their beauty. Like all central African tribes, the Niam Niam, especially the men, take marvelous pains in dressing their hair. Polygamy is practised among them, yet the marriage bond is held sacred, and the Niam Niam men show a deep affection for their wives. Loathsome as they are in their cannibal habits, these people yet show some admirable characteristics, and an intelligence considerably above that of most African tribes.

The great hall in which King Munza danced before his wives, Schweinfurth describes as a wonderful structure, more than one hundred feet long, whose spars and rafters were the leaf stocks and mid-ribs of the wine palm, from twenty-five to thirty-five feet long, the brown surfaces shining as tho freshly varnished. The floor was a hard, smooth, dark red clay; and the lofty arch of the roof, which was surpassed in height only by the loftiest oil palms, was supported on three long rows of pillars, each one a tall, straight tree trunk.

North of the Niam Niam country is Dar Fertit, or country of the Fertits. It is one of the oldest domains of the slave raiders. So long and so successfully did they carry on the traffic that Schweinfurth, thirty years ago, described the country as like a sold-out land—sadly depopulated. Many slave dealers settled in the country, establishing depots for the more convenient handling of their human merchandise. Chief among these, thirty years ago, was Seebehr, the richest and most powerful slave owner of the Sudan at that time. His Zeriba,* as described by Schweinfurth, was princely in its magnitude and appointments. The spacious appartments were guarded day and night by armed sentinels. Richly dressed slaves moved noiselessly about, serving coffee and sherbet to honored guests. Lions added a touch of royalty to this oriental court. The whole establishment consisted of several well-built square huts enclosed by tall hedges, composing the private residence, and of hundreds of farmsteads.

Sir Samuel Baker as Governor General of the Sudan, and General Gordon in the same capacity, drove the slave trade from the Nile waters. Overland routes were chosen instead, however, little known and impossible to guard; and Gordon never ceased to lament his inability to stop the traffic entirely. It is an open question whether the slave trade is even yet suppressed. There are ways of smuggling human as well as inanimate merchandise, and a system that is so deeply rooted as slavery is in the Soudan can not be destroyed in a single generation.

North of Dar Fertit, occupying the headwaters of Bahr-el-Arab, is Dar For, or Dar Fur. Like Dar Fertit it was also one of the strongholds of the slave trade, tho it was never so sadly decimated as the former unhappy country. The Fors and the Fertits were the original Negro inhabitants. Then came the Bedouin tribes and partially conquered the country; for, in crossing the parallel of 10° N. Latitude, we have entered the land of the camel and the Arab. South of that line the camel does not thrive: but to the north of it the two roam together, carrying with them the religion of Mohammed. In the village of Shaka, one of the chief centers of the slave trade, Gordon found a number of ancient swords, precisely similar to those the Crusaders used —evidence of an Arabian immigration into the Sudan soon after the Crusades. These fierce, nomadic, semi-independent Bedouins were merciless slave raiders under the old regime, and are equally merciless in warfare to-day.

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*Literally a thorn hedge. The name is applied thruout the Soudan to any structure, or group of structures, enclosed by a protecting hedge or wall.

Resuming our survey of the country along the main stream at Lake No, we find ourselves between the Shiluks on the left and the Nuers, already mentioned, on the right; two tribes as repulsive in appearance as any to be found on the Dark Continent. The Shiluks cover the body with a coating of ashes to protect them from insects, which gives them a ghastly grey or a rusty red hue, according to the material from which the ashes are obtained. They knock out the lower incisors, are almost destitute of clothing, but dress their hair most elaborately, gluing it into all sorts of fantastic shapes. Their country extends along the river for a distance of three hundred miles, occupying a territory from ten to twelve miles wide, beyond which are the Baggara. or Cattle Bedouins. The dense population of the Shiluk country testifies to the richness of the land. The dome-shaped huts of the natives are so closely crowded as to look like clusters of mushroons, and village succeeds village at intervals of a few yards. The population is estimated to be about 625 to the square mile. Schweinfurth says, "Everything which contributes to the exuberance of life, here finds a concentrated field—agriculture, pasturage, fishing and the chase."

At the entrance of the Gazelle, the Nile bends strongly to the east, and, about sixty-two miles farther on in its course, it receives from the south-east the waters of the Sobat. Where it enters the Nile the country is low and flat, but the turbid character of the water shows the stream to be fed by mountain torrents. It is on the precipitous slopes of the Abyssinian plateau—henceforth so important to the great river—that the head waters of the Sobat are to be found. There, Dr. Beke tells us, the stream flows thru a forest so dense as to completely exclude the sun's rays.

It is the milky whiteness of the Sobat waters that gives the name Bahr-el-Abiad, or White river, to this part of the Nile. Altho the name White Nile is given to the entire main stream, above Khartum, it is strictly applicable only to the portion between the entrance of the Sobat and the Blue Nile.

Beyond the Sobat the right bank of the Nile is occupied by the Dinka country, the most extensive on the White Nile. The Dinka dispute with the Shiluks and the Nuers the distinction of being the most degraded of African savages. They are great breeders of cattle; and, notwithstanding their low estate, they are said to be the best cooks in Africa.

The mouth of the Sobat is about equally distant between Lake No and Fashoda, Lat, 10° N., Lon. 32° E., noted for the incident that so nearly caused war between France and Great Britain a few years ago. A decided change takes place in the character of the country as we leave Fashoda: the dominating slope of the Abysinian uplift deflects the Nile to the north; the sudd region is left behind; rainfall becomes more and more scant, and vegetation correspondingly less luxuriant; mimosa thickets replace the ambatch, so characteristic of the swamp region; we are in the land of the camel and the Arab again, and soon the Baggara replace the Shiluks along the river banks.

At the mouth of Bahr-el-Azrek, or the Blue river, stands Khartum, where the noble Gordon sacrificed his life for love of duty; and opposite Khartum is Omdurman, where, fourteen years later, in 1898, the forces of the Mahdi were defeated by General Kitchener, when Great Britain resolved to re-occupy the Sudan. The tongue of land included between the Blue Nile and the main stream is Dar Sennar, flat and monotonous, but suited to the cultivation of cotton, tobacco and dhurra, which are raised there by the various tribes inhabiting that region.

Forty-two miles north of Khartum the Nile again makes an abrupt descent, the first since it foamed over the rocks of Fola rapids. This is at the sixth cataract, where, in a distance of a little more than one mile, the slope of the bed is about twenty feet. In the northward course of the river the rainfall has grown ever less and less. The arid region on either side shuts in closer and closer upon the liquid ribbon of the river. More and more desert-like grows the broad expanse of country on either side. The extreme wretchedness of this part of the Sudan is remarked by all who have seen it.

The country lying between the Atbara, the Blue Nile, and the main streams, was anciently known as the Island of Merol. It is here, twenty-seven miles north-east of the modern town of Shendi, that the voyager down the Nile first meets with monuments of an ancient civilization; for here a group of pyramids marks the site near which stood the ancient city of Meroe, whose history is so little known to the modern world. The Blue Nile and the Atbara are Abyssinia's contribution to the River of Egypt, and we may well turn aside at this point, to consider this interesting corner of the Nile country.

Abyssinia is the Mexico of Africa. Nearer the equator than Mexico and more contracted in area, the great plateau mass is lifted to a greater altitude; but each rises abruptly from a level surface by successive steps, giving rise to different zones of climate, hot near the base, temperate on the middle heights, and cool upon the summit plateau. The more gentle slopes of the Mexican tableland are lapped at base by the waters of two great oceans; while the precipitous heights of the great African uplift rise tier on tier above a sea of yellow sand. What looks like a range of lofty mountains skirting the horizon to the southeast of the Nile as it passes thru the eastern Sudan, is in reality the stupendous wall of the Abyssinian plateau, which rises above the desert like a rocky island above the ocean.

Lifted ten thousand feet into the atmosphere of the torrid zone, with table-topped mountains that rise several thousand feet higher, its level surface is rich in all that conduces to the comfort of mankind: green fields and rich pastures alternate with shady groves; streams of clear water flow abundantly; fruits and food stuffs of the temperate zone are grown on the summit plateau, and those of the tropics at lower heights. A singular feature in the landscape are the flat-topped rocks, called Ambas, that rise abruptly here and there, whose irregular summits look like the battlemented walls and towers of a mediæval city. Some of these Ambas are used as prisons, the prisoners being hoisted up by basket and rope, there being no possible road. Others are more accessible, and have water and cultivated ground on top.

The successive terraces that occur on the precipitous sides of the plateau and the streams that rush so tumultuously on to the plains below, furnish rare sport for the lovers of big game. Multitudes of giraffes, baboons, buffaloes, antelopes, hyenas, lions, and elephants roam thru the wilderness, while the crocodile and the hippopotamus, so ever present along the Nile, are not wanting here.

This whole unique plateau of Abyssinia is tilted gently to the northwest, throwing its entire drainage into the Nile system. Near the southern border lies Lake Tsana, forty miles long by thirty broad, from which flows Bahr-el-Azrek, the Blue river, or Blue Nile as it is called; and within a few miles of the lake rise the head waters of the Takazze, a tributary of the Atbara. These two rivers, the Azrek and the Atbara, with their tributaries, clasp the rugged walls of the great plateau on its northern and western faces, scooping out frightful chasms in its precipitous sides, and bearing the material down to build up the fertile Nile valley and its delta.

Like all rivers that have their source in lakes, where sediment can settle, the Blue Nile issues from Lake Tsana a clear stream, that reflects the blue color of the sky in time of low water; hence, Bahr-el-Azrek, the Blue river. Thanks to the perennial supply of water furnished by its lake reservoir, the Blue Nile is a considerable stream thruout the year. It is the last permanent tributary the Nile receives. During the rainy season the Rahad and the Dinder, ghastly torrent beds in the dry season, pour vast quantities of water laden with red mud to the Blue Nile. With this addition to its volume it rushes down the westward declivity, flowing on more slowly past the tobacco and cotton and dhurra fields of Senaar and Meroe, pouring its red flood into the Nile at Khartum.

On the shores of Lake Tsana remains of Greek architecture may be seen. These mark the most southern point to which Greek influence extended, as well as the uttermost region to which Christianity was carried in the early centuries of the Christian era. The Abyssinians are of Semitic origin, and their kings love to claim descent from Solomon, King of Israel. Their isolated position on the summit of a plateau so difficult of access has kept them shut out from the great family of nations; but their history during the nineteenth century furnished some picturesque incidents, as when the heights of Magdala, hitherto deemed impregnable, were successfully stormed by Sir Robert Napier, with elephants to carry his heavy ordnance up the precipice, and camels for lighter work.

The crushing defeat of the Italians at Adowa, in 1896, by King Menelek, secured him the respect of all European sovereigns; a respect which his dignity of character, his kindly, courteous bearing, his keen intellect, and his evident desire to deserve the good opinion of civilized rulers, render him worthy to retain.

The importance of the Atbara in the regime of the Nile was finally established by Sir Samuel Baker. Turning aside from the main stream in the summer of 1861, he made a careful exploration of the Abyssinian tributaries. Arrived at the mouth of the Atbara in June, he found it quite dry, except for a succession of deep pools inhabited by crocodiles, rhinoceroses, and other water loving animals. The bed of the stream was about four hundred yards wide, and the banks, twenty-five to thirty feet high, were evidently overflowed in time of flood. The party encamped on the clean sand of the river's bed, but were awakened in the night by the cry of "El Bahr! El Bahr!" and they made haste to flee from the coming flood. Not a fleck of cloud had been seen for days, or the faintest flash of lightning; but the heavens were pouring their floods upon the Abyssinian heights, and this was the advance guard of the torrent. The next morning a mighty river, five hundred yards wide and from fifteen to twenty feet deep, was rolling over the spot where they had pitched their tents. The first floods do not always reach the Nile, being sometimes swallowed up by the thirsty sand. It is only when this has been saturated that the surplus waters pass on to swell the Nile flood.

Up the tributary torrents, the Settite or Taccazze, the Angarep or Angrab, the Salaam, and the Royan, the region of periodic rain is entered. Here the country is richly wooded and very beautiful, tho seamed and scarred by frightful chasms scooped out by the wild torrents that rush thru it in the rainy season. But the land of the lower Atbara, Bahr-el-Azwab or the Black river, as the natives call it, like that of the lower Nile, is one vast desert with a narrow band of trees along the river. Spanning the gorge of this last Nile tributary, may now be seen the Atbara bridge, an impressive witness to American enterprise, American dash, and swiftness of execution.

The term "basin" ceases to be applicable to the Nile country at the entrance of the Atbara. From that point to the sea, except for the wadies that make occasional contributions, the Nile system is confined to the valley of the river, a narrow, winding trough, thru which the waters of the interior basin find exit. From this point to the delta we have the desert ever present with us, just beyond the brilliant green of the palm groves and dhurra fields that border the silver stream on either side. Not a single tributary enters the river in all that distance; scarcely a shower falls from year to year; the dry, hot air causes enormous evaporation: but still the great stream holds its own, winding coil on coil for fifteen hundred miles over the sands of a burning desert, unconquerable in the majesty of its life-giving flood. No wonder the two-fold mystery of perennial flow and periodic rise in a country that scarcely knew the meaning of cloud, has fascinated the greatest minds since the days of the Pharaohs. By the discovery of the great lakes and swamps of central Africa and the study of the Abyssinian tributaries that double riddle has been solved. For the great Nyanzas and the swamps of the sudd region stand in the same relation to the Nile as does the American chain of great lakes to the St. Lawrence; and tho all streams contribute towards the annual overflow, the Blue Nile and the Atbara are the most important factors in its production.

The White Nile begins to rise at Khartum about the end of April, being swollen by the rains of February over the Great Lakes, and by contributions from the Gazelle and the Sobat, as the northward advance of the equatorial rain belt causes increased precipitations over their basins. This first flood of the Nile reaches Lower Egypt near the first of June, but subsides in a few days. It is called the "Green Nile;" for the waters, filtered thru the marshes of the sudd region, are charged with vegetable matter and are wholly unfit to drink.

The great flood begins when the melting of snow and the excessive spring rains swell the torrents of Abyssinia. The Blue Nile, changed to red by the vast quantity of ferruginous earth it holds, carries its flood past Khartum about the middle of May, reaching Syene about the 8th of June, and Cairo by the 17th to the 20th. About this time the Atbara, changed in a single night from dry bed to mighty river, adds its vast contribution, and the flood now increases rapidly. About the middle of July it is considered high enough to submerge the land adequately. The dykes which confine it and the barriers across the mouths of canals are then opened, and the fertilizing waters allowed to spread over the lowlands to the very edge of the desert. "Egypt is then one sheet of turbid water spreading between two lines of rock and sand, flecked with green and black spots where there are towns or where the ground rises, and divided into irregular compartments by raised roads connecting villages."*

This is the "Red Nile," so highly prized by the Egyptian fellahin† for the rich red earth which it brings down from the Abyssinian highland; for tho the waters carry whitish clay from the Great Lake region, and sand from Nubia, it is the ferruginous earth from Abyssinia's volcanic rocks that gives the characteristic color. Muddy tho it is, the water is not unwholesome like that of the Green Nile. The flood is at its greatest height in Nubia about the end of August, and at Cairo three or four weeks later. It remains stationary about eight days, then falls as rapidly as it rose, and by December has retired to the limits of its bed. The changing appearances brought about by the annual overflow were happily designated by Herodotus as the silver flood of high Nile, the emerald green of growing crops, and the golden harvest of ripened grain.

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*Maspero: "Dawn of Civilization in Egypt."

†Farmer.

The six cataracts between Khartum and Assuan are important factors in regulating the overflow of the Nile. At these places the waters of the Nile are held back before they drop from higher to lower ledges of the continental plateau. There are thus six catchment basins, one above the other, in which the water collects and flows out uniformly, thus preventing a too rapid rise. Without this saving feature, the river, which rises by such furious leaps and bounds, would become a devastating flood.

Between Abou-Hamed, Lat. 19½° N., Lon. 33⅓° E., and Korosko, 22½° N., 32¼° E., a caravan route across the Nubian desert, 230 miles, has been in use from time immemorial, cutting off the great westward bend of the river. It is a terrible journey over a dead level plain of orange-colored sand, with crags of black basalt jutting out above it and volcanic bombs scattered over it in places, telling of past volcanic action. Vultures follow the caravans, singling out the sick camels with unerring precision, and circling above, ready to drop upon them as soon as they fall. Weird stories are told of thirsty travelers, trusting the evidence of their senses rather than the wisdom of their guides, turning aside from the beaten track to follow phantom waters, never to be heard of more.

Yet when all goes well, the desert has a strange fascination in its solemn silence, its illimitable horizon, the fantastic mirage, the mysterious dawn creeping over the star-lit sky, the sunset flushing earth and sky with a thousand tender hues. At night the moonlight floods the earth with a brightness that shows objects in their natural colors as by sunlight; the stars shine with the steadiness of planets; and the rapid radiation thru the vaporless air brings delicious coolness.

Three cataracts are avoided by this desert detour: the fourth; the third, which is called the Cataract of Hannek in its upper reaches and Kaiber Cataract further down; and the second, or Great Cataract, which ends just above Wady Halfa. This is the Batn-el-Hajar, or "belly of rocks." It is 124 miles in length and falls 216 feet. The cliff that skirts the river along this cataract terminates abruptly in the Rock of Abusir, the dread of navigators of the Nile.

Beyond the second cataract, which marks the southern limit of modern Egypt, the desert crowds in upon the river more and more, and the scene becomes wild in the extreme. Amelia Edwards thus describes the view near Korosko. "The Nile curves grandly thru the foreground. The palm woods of Derr are green in the distance. The mountain region which we have just traversed [passing up stream] ranges, a vast train of multitudinous peaks, round two-thirds of the horizon. Ridge beyond ridge, chain beyond chain, flushing crimson in light and deepening thru every tint of amethyst and purple in shadow, those innumerable summits fade into tenderest blue upon the horizon. As the sun sets they seem to glow; to become incandescent; to be touched with flame—as in the old time when every crater was a fount of fire." It is the Nubian range of mountains she refers to; and they follow the course of the Nile under different names, now at a distance, now closing in upon it, until, in the city of Cairo, the last spur of the Mokattam range abruptly terminates, crowned by the citadel of the great metropolis.

We have not gone far beyond the second cataract before half-buried ruins begin to show themselves along the river. More than a dozen temples, with numberless tombs, grottoes, and other ruins are to be seen in this savage desert between the second and the first cataract. Most impressive of these is the great rock-cut temple of Abu Simbel, with its colossal statues of Rameses the Great. The natives along the bank still draw water from the river with the shadoof and the sakieh as in the days of the Pharaohs. Thousands of years ago—no one knows how many—the Princess Nefert braided her hair and sat for her portrait statue to the favorite sculptor of the time: and to-day, the Nubian women dress their hair in precisely the same fashion, and come to the Nile for water. Verily, fashion is not fickle among our brown sisters of Nubia.

The first cataract begins in Lat. 24° N. and extends about two-thirds of the way between the beautiful island of Philae with its picturesque ruins, and the green island of Elephantine opposite Assuan, 24½° N. It was anciently called the Gateway of Nubia, and it marked the southern limit of ancient Egypt; for tho the empire extended far beyond, Egypt proper was confined to the narrow valley between Philae and the sea. The inhabitants dwelling beyond the Cataract Gate were the "vile race of Kush" to the ancient Egyptians.

At the first cataract the river makes its final plunge from the granitic rocks of the primitive continent to the sandstone of a later formation. Here, on the site of ancient Syene, which gave its name to the rock we call syenite, every variety of granite can be found—pink and red syenites, yellow, gray, black, white, and porphyritic granite, black granite veined with white, and white veined with black. Just above this point the River of Egypt passes from torrid to temperate zone; and there the ancient astronomer set up his gnomon, to mark the most northern point of vertical sunlight. It was from observations at Syene, and at a point on the Hellespont, that Eratosthenes first measured the circumference of the earth; and the first meridian drawn by ancient geographers connected Syene with a point on the Black sea. Of the hundreds of picturesque islands that rise above the seething flood of tumultuous waters, the most interesting is Philae at the head of the cataract, held sacred as the supposed burial place of Osiris; and on Elephantine, at the foot, is to be seen the Nilometer, which from time immemorial has measured the height of the Nile flood.

Four miles south of Assouan, work on the great Nile dam is being rapidly pushed. This wonderful structure will be a wall of solid masonry one hundred feet high, seventy-five feet wide at base, a mile and a quarter long, and wide enough at top to serve as a bridge. By means of it the angry waters of the cataract will be converted into a peaceful lake, which will extend beyond Philae, nearly to Korosko. It will be nearly three times as large as Lake Geneva, Switzerland, and the outflow, controlled by sluice gates, will add nearly 2500 square miles to the cultivable area of Egypt. The building of this great dam will restore, to a certain degree, conditions that anciently existed; for the presence of an abandoned river channel shows that a part of the Nile once flowed to the east of its present course, until, having broken thru a rocky barrier at Silsilis, about forty miles below Philae, it assumed its present channel.

The narrow valley of the Nile between the first cataract and the delta was the Upper Egypt of ancient history. It is never more than a few miles between the cliffs on either side, the average distance being about twelve miles; and at any point above Cairo the whole breadth of the green, cultivated valley, with the river sunk below and the bounding cliffs on either side, may be seen from a little elevation. On the upper level of the cliffs that shut it in, stretches the limitless desert with its shifting sands and its barren, precipitous mountains. This narrow trough, Herodotus thought, was anciently an arm of the sea filled in by deposits of the Nile; hence his expression, "Egypt is the gift of the River." But modern examination does not bear out this theory; for thruout the entire valley the river alluvium rests directly upon the bed rock, with no marine deposits intervening.

The civilization of ancient Egypt advanced up the river from the delta. Consequently, in passing down stream we find ruins more ancient than those above. The temples of Philae belong to the Greek and Roman periods. Leaving this beautiful island behind, the temples of Kom Omho, Edfu, and Esna are passed in succession; and then we reach the Thebaid with its cluster of marvelous ruins, Karnak, Luxor, the Memnon, and all that remains of Thebes, the once proud capital of the world's greatest nation. Everywhere the new overlaps the old. Relics of all the ages and of many nations may be found along this stream. Mohammedan mosque and Christian church stand side by side with pillared temples buried up to their capitals in sand; the palaces of government officers and the huts of the native Copts* within sight of the tombs of the Pharaohs; sugar houses with the most modern appliances close by the primitive shadoof and the sakieh,—devices as old as the pyramids, as the sculptures show. The camel and the ass are still the beasts of burden; but the locomotive whirls the passenger from Cairo past Karnak and Luxor and the great Rameses of the Nubian desert, over the Atbara bridge, past the pyramids of Meroe, on to Khartum in the heart of the great Nile basin.

About seventy miles below the first cataract, limestone of Cretaceous formation overlaps the sandstone and forms the bed rock of the river thruout the rest of its course. For miles the limestone cliffs of the remoter wall of the valley are honeycombed with the rock-cut tombs of ancient Egypt. There are hundreds in the face of Jebel Ahufyeda; and the tombs of Beni Hassan are famous for the rich historic treasures they have yielded.

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*Descendants of the ancient Egyptians.

The valley of the Nile between the first cataract and the delta has two expansions, which exceed even the valley itself in point of fertility; these are the Thebaid, already mentioned, and the Fayum, a fertile basin sunk below the general level. These produce an inexhaustible supply of food stuffs in endless variety, chief among which are the date palm, wheat, barley, and dhurra corn. Fruits of many kinds, of both tropical and temperate climes are produced in abundance. The Fayum is watered by Bahr-el-Jusuf, a branch of the Nile, named, not for the Hebrew Joseph as is sometimes asserted, but for Salaheddin Jusuf, the Saladdin of the Crusades, who rendered it more effective.

At the northern extremity of the Nile valley where it spreads out upon the delta, is the city of Cairo, the modern representative of ancient Memphis. And on the opposite side of the river, on the upper platform of the Libyan desert, stand the most ancient monuments of Egypt's history—the great pyramids and the sphinx—structures that already looked back upon a remote past when Joseph was sold into Egypt. If we would recall the picture of the Nile in those distant times, we must restore the thickets of papyrus with its funereal plumes, the crocodile and hippopotamus, as well as many other characteristic plants and animals that have retreated up the river; but the lotus is still there, floating its green pads and its golden hearted blossoms on the Nile waters, as in the old time when Pharaoh's daughter found the child Moses among the bulrushes.

Just beyond Cairo the river enters upon the last stage in its journey to the sea. There it divides into two branches, each of which again divides and subdivides, the interlacing waters spreading out into frequent lakes and wandering slowly over the flat, alluvial plain which forms the delta. This is the Lower Egypt of history. At the mouth of the northwest, or Rosetta branch, stands the city of Alexandria; while the eastern part, or region of the Damietta branch, was the locality in which the Hebrews settled when Joseph persuaded his brothers to follow him into the land of the Pharaohs. In ancient times the delta was the granary of the Orient. Cotton and sugar have been added to its important products in more modern times, and the nineteenth century saw the completion of the Barrage, a great dam built across the two branches of the Nile at its bifurcation. By this great feat of modern engineering skill, suggested by Napoleon, begun by Mehemet Ali, designed and planned by a Frenchman, Mongel Bey, tens of thousands of acres of waste land have been brought under cultivation.

Such, briefly considered, is the country of the Nile. At its source we find complexity of physiographic structure and simplicity of social conditions; in its lower reaches, simplicity of geographic environment and ethnic complexity. Along the fertile valley of the lower Nile, all the civilized nations of the globe, from remotest time to the present, have passed and re-passed; while the upper Nile knows only primitive tribes on whom the light of civilization is but just dawning. The great world conquerors from Rameses to Napoleon have left their impress on the lower Nile; but what history has in store for the country of the great Nyanzas remains yet to be determined.

Let us place ourselves in imagination on the shores of Lake Victoria and glance northward down the great river. We stand four thousand feet above the ocean; and from the shores of the beautiful lake there spreads a charming, park-like country of alternating forest and prairie, with rich pasture lands where thousands of cattle browse. Mountains rise above the tableland; at our left, towering Ruwenzori, with the pale blue waters of Lake Albert Edward in the Rift valley at its feet. Clear streams flow abundantly, giving life to the tropical vegetation. We see the lake narrow to its outlet, the Victoria Nile, and, gliding over Ripon falls, sweep onward down the steep descent, to join the Albert Nyanza among the splintered crags of the Great Rift valley. Almost immediately it passes out again with the waters of Lake Albert; and at Lado it leaves the upper plateau, to wander thru the desolate swamps of the sudd region, receiving as it goes the waters of the great Gazelle system and the milk white flood of the Sobat.

Passing into the Egyptian Sudan we see the lofty plateau of Abyssinia far to the east, ten thousand feet above the sea, and the mountain torrents tearing down its precipitous sides, foaming and roaring, laden with Abyssinian soil for the Blue Nile and the Atbara. We see the great cataracts, and the desert crowding in upon the liquid ribbon of the river until it is ever present with us; rising in terraced rocky heights, in conical peaks with volcanic bombs scattered about their base, or rolling in hills of golden sand; but always the desert, desolate, limitless.

We follow the strip of green with its waving palms along the river. Evidences of a past civilization begin to appear, and soon the face of the great Rameses, cut in the everlasting rock, looks upon us from the desert. We see the first cataract, and the sacred island of Philae with its picturesque rocks and ruins. And from there down the eye sweeps past monuments of all the ages, crowding upon each other on the green banks: sublime Karnak amid the huts of the fellahin; glorious Thebes, a heap of ruins; great Memphis of old, a few mounds of rubbish; and close by, the mosques and minarets of modern Cairo, all fresh and sparkling, with the great pyramids standing in solemn majesty above the plain, on the edge of the desert. The fertile expanse of the Fayum lies on this side; and over there the silver thread splits again and again, to wander over the flat, triangular delta. Beyond that, Alexandria and the blue waters of the Mediterranean.

Our imagination has traversed the entire northern half of the torrid zone and more than eight degrees of the temperate. The equinoxial sun shines vertically down upon us as we stand upon the lake shore. Looking northward to the Mediterranean we see his rays slanting more and more, until they touch the distant sea at an angle of 32° with the vertical. Cloud and atmospheric effects are various. Above us are frequent clouds and almost daily rains; while the gorgeousness of the Uganda sunsets, with their masses of crimson and purple and gold is attested by those who have witnessed them. Northward, the rain becomes less and less, until over the Egyptian plains are the intensely blue skies of the desert, with scarcely a fleck of cloud to obscure the sun; and as the great disk sinks below the far horizon, earth and sky are flushed with a thousand tender hues, soft half tones and neutral tints, that shade into each other in endless delicate gradations. When we reach the delta moisture increases, until at Alexandria rain is frequent.

Finally, if we compare the River of Egypt with other great streams of the globe, we find that in area of basin it is exceeded only by the Mississippi and the Amazon; while the great Father of Waters wins the palm for length by a bare thirty miles.*

Principal works consulted: Maspero—Dawn of Civilization in Egypt; Rawlinson —Herodotus, Ancient Egypt; Gregory—The Great Rift Valley; Speke—Source of the Nile; Stanley—Through the Dark Continent, In Darkest Africa; Schweinfurth—Heart of Africa; Birkbeck Hill—Gordon in Central Africa; Reclus—The Earth and Its Inhabitants; Henry Gordon—Life of Charles Gordon; Baker—The Albert Nyanza, Nile Tributaries of Abyssinia; De Cosson—Cradle of the Blue Nile; Sanderson—Africa in the Nineteenth Century; G. W. Steevens—With Kitchener to Khartum; White—Expansion of Egypt; Edwards—One Thousand Miles up the Nile; Mariette—Monuments of Upper Egypt.

THE INFLUENCE OF UNDERLYING ROCKS ON THE CHARACTER OF THE VEGETATION

(Continued from page 176)

BY HENRY C. COWLES, THE UNIVERSITY OF CHICAGO

II. Gneisses, syenites, schists, diorites, basalts, diabases, serpentines, etc. With the granites there may be associated the other compound crystalline silicates. These various rock types differ more or less widely in the percentage composition of silica and also lime, soda, magnesia, iron, and other elements. Again there are differences in the physical makeup of these rocks, some being of coarse texture and others fine. It is probable, however, that the differences, whether physical or chemical, are insufficient to cause any marked variations in the vegetation. Dioritic rocks at Marquette, in texture like the granites, but with less quartz and more of various felspar elements, have essentially the flora of the granite. The same lichens appear at the outset, the same crevice herbs and shrubs in later years, the same tree stages as the conditions become more mesophytic. Furthermore the duration of these stages approximates what has been described above for the

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*Approximate areas: Amazon, 2,800,000 square miles; Mississippi, 1,390,000 square miles; Nile, 1,840,000 square miles. Lengths: Missouri-Mississippi, 4230 miles; Nile with Nyanza headstreams, 4200 miles.—*Reclus.*

granites, since the erosion of diorite is also very slow. At Marquette the plants of the early stages are even more similar on the above two rocks than are the trees that follow. Since rocks are more unlike than the soils that come from them, and since soils become more and more alike until they ultimately become similar, it is obvious that the first stages, if any, would be the ones to show differences. Since, however, these stages are the same, it may be concluded that the life history of granites and diorites is the same from start to finish.

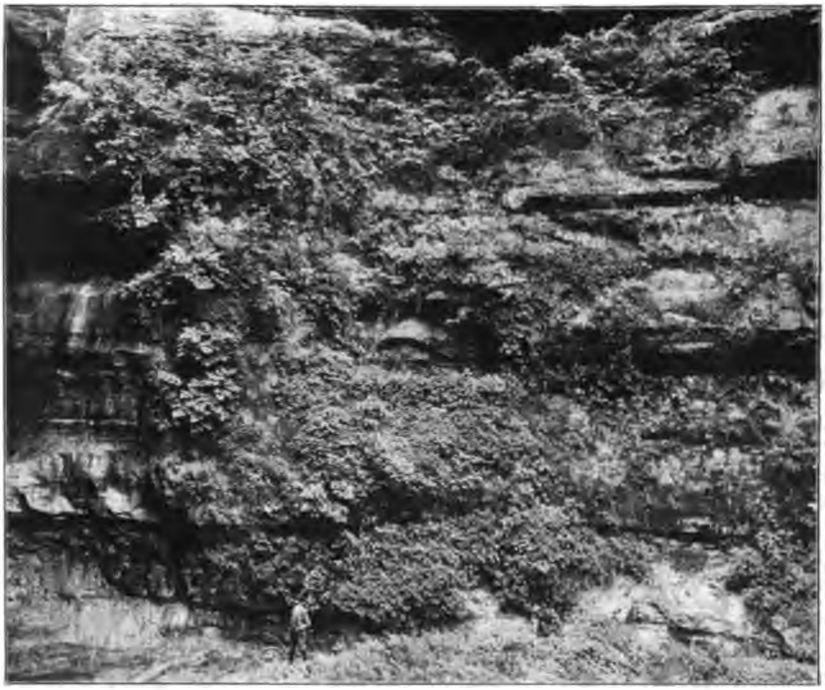

FIG. 5. Ravine slope in St. Peters sandstone (Ordovician) at Starved Rock, Ill. This cut shows a luxuriant mesophytic vegetation of liverworts, mosses and shade plants. Limestone ravines in the vicinity show the same vegetation.

What is true of diorite is in general true of the remaining compound silicates. The basaltic hills of Connecticut have essentially the flora of the neighboring granite hills, altho basalt differs from granite physically as well as chemically. The percentage of silica is still less than in diorite, while various basic minerals, rich in iron, magnesia, etc., increase. The texture is much finer grained than in granite or diorite. Some floral differences have been noticed; for example the lichen stages seem to be more fully represented on the granite than on the basalt. This may be due to the more rapid and more uniform erosion of the basalt; the lichens thus get a foothold with some difficulty but do not retain their place so long as on the granite. Basaltic rocks break up with ease mechanically, showing a conchoidal fracture. In Connecticut, talus slopes are thus developed at the base of the basalt ridges. The flora of these talus slopes is of great interest in a study of this kind, since the development is extremely rapid. Tho the rock character is, of course, precisely that of the ridges, the flora soon becomes mesophytic, since humus accumulates readily and since moisture is conserved. As a consequence one may commonly see a xerophytic basalt ridge with mesophytic talus slopes. At times the ridge possesses conifers, while deciduous trees occur on the talus; in this event the difference is very sharp indeed.

Gneisses and schists differ from granites, diorites, etc., chiefly in their physical properties. Schistose rocks erode more readily than do granitic rocks, and hence furnish a less secure footing for lichens. The crevice herbs and shrubs and finally the trees appear in relatively rapid succession. Serpentines are decomposition products from other rocks and are rather resistant to the processes of erosion. Serpentines derived from basalt were studied in Marquette and showed some floral differences from the granites. Lichens were abundant, but the vegetation in general seemed sparse, tho the tree stages resembled those of the granite. The occurrence of ferns peculiar to the serpentine rocks of Europe has already been noted. The fact that the cultivation of these ferns in other soils destroys their specific characters is a strong argument in favor of the idea that the physical or chemical character of serpentine influences plant development. The Marquette studies were too superficial to permit any observations of the kind just noted, but an interesting line for further study is here suggested.

III. Quartzites. These rocks present vegetation conditions that are of much interest. Chemically, quartzites are very close to the sandstones and may be regarded as having arisen from them thru metamorphic processes. In each case quartz is the chief constituent, but in quartzite the rock is homogeneous, compact and shows a lustrous surface on fracture, characters that are not true of sandstone. As a consequence of its chemical insolubility, and its physical homogeneity, quartzite erodes with the greatest of difficulty. Other things being equal, quartzites will be among the last rocks to show a lichen coating, and among the last to display mesophytic vegetation. Observations made at Marquette gave support to this idea, but the general drift covering greatly interfered with any satisfactory study. An exhaustive study should be made of quartzite outcrops in some driftless area. It seems almost certain, however, that the ultimate fate of the quartzite vegetation will be that which has already been recounted for granite, diorite, and basalt, but that the passing of the stages will be vastly slower.

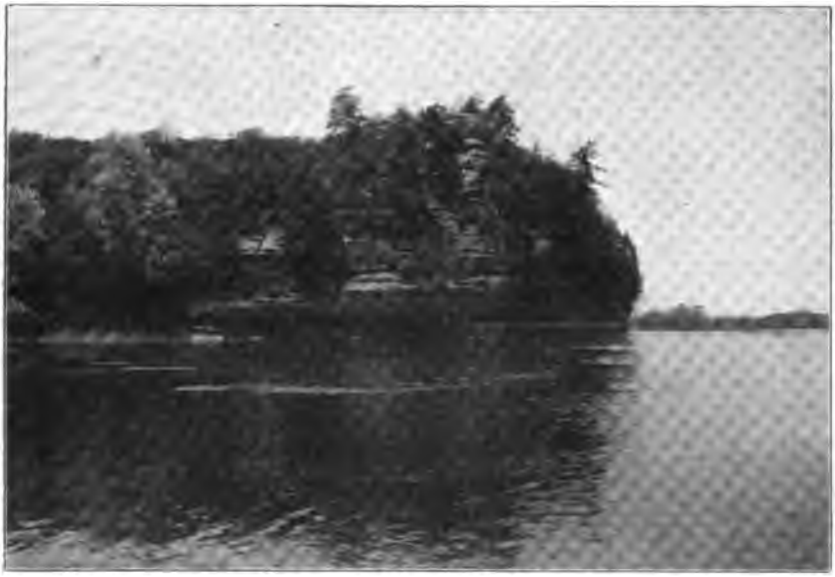

FIG. 6. Bluff in St. Peters sandstone (Ordovician) at Starved Rock, Ill. White pines (*Pinus Strobus*) and other xerophytic plants are seen on the exposed rock surface. Limestone bluffs in the same region show similar forms.

One of the remarkable results brought out by a study of rock vegetation in Montana during this past summer is that many species are identical with those of the east, when grown in similar conditions. For example the harebell (*Campanula*), *Selaginella rupestris*, the juniper (*Juniperus cummunis*), and the yarrow

(*Achillea*), all of which have been found to be characteristic members of the early stages of eastern rocks, are also characteristic of the quartzites of the Rocky mountains, in the alpine regions as well as on the lowlands.

IV. Sandstones. These well-known rocks are composed chiefly of quartz grains, held together by ferruginous, calcareous, or siliceous cements. Chemically, then, sandstones are much alike so far as the dominating constituent is concerned; for that matter they also resemble quartzite, as has been previously indicated. Physically speaking, sandstones differ as the cements differ; where the cement is calcareous, decomposition is easy, where it is siliceous, decomposition is difficult. When alteration takes place so that the granular sandstone passes into the lustrous quartzite, decomposition becomes all but impossible.

As Special comparative study of the vegetation of sandstone exposures was made in northern Michigan, northern Illinois, and eastern Tennessee, and some very instructive results were obtained. In Illinois the sandstone studied was of the St. Peters (Ordovician) formation. The rock in general decomposes very readily, giving rise to extensive sand deposits, thru the loss of the cement; it is even possible to crumble exposed portions of the rock in the fingers, except where an iron oxide cement makes the rock much more resistant.

The Carboniferous sandstones of Tennessee are much more resistant because the cement is less soluble. The Lake Superior (Cambrian) sandstones of Michigan occupy an intermediate position between those of Illinois and Tennessee.

The primitive vegetation of the sandstone was found to vary in harmony with the variations in physical character of the rock. The resistant rocks of Tennessee showed well developed lichen stages, whereas the friable St. Peters sandstone of Illinois in many places was entirely without a lichen covering. Where the latter rock has resistant portions cemented by iron oxide, the lichens are abundant. On the other hand the crevice herbs and shrubs start readily in the more friable rock, but much less readily in the harder rock. As a result of these conditions it will be seen that the areas of St. Peters sandstone must soon be decomposed quite generally and carpeted with a more or less rich vegetation. The areas of more durable rock, such as those noted in Tennessee, must remain much longer in a xerophytic condition. A very casual observation shows that these conclusions are correct; the contrast is very sharp between the great sandstone hills of eastern

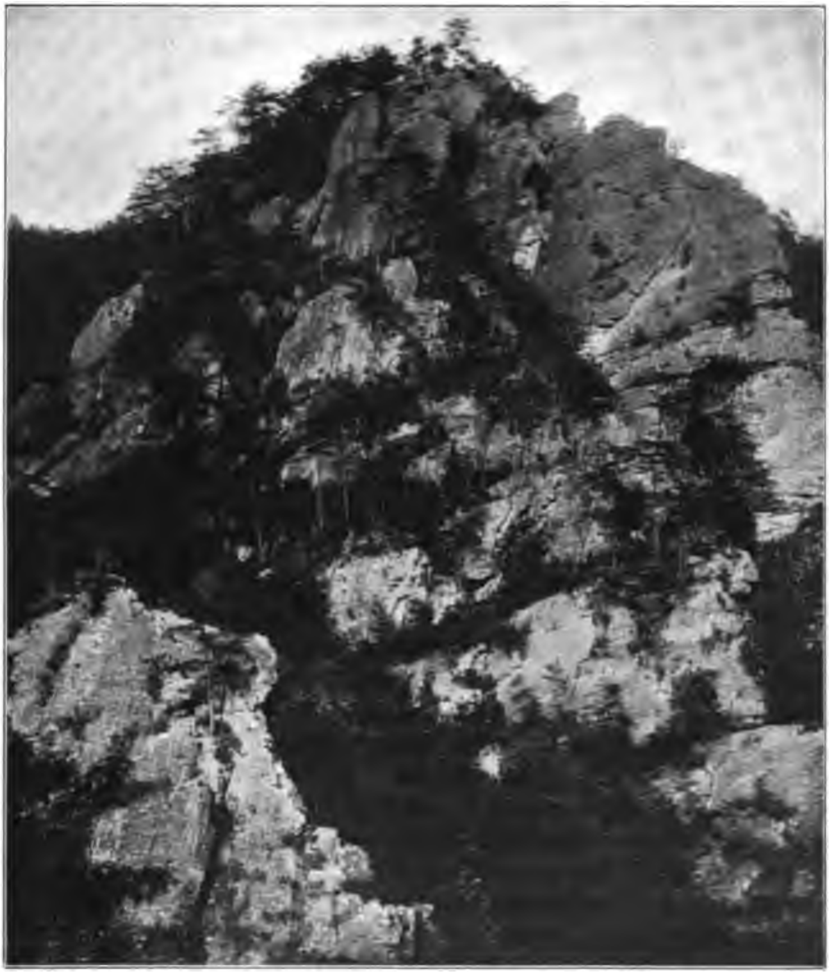

FIG. 7. Cliff of Carboniferous sandstone, Cumberland mountains, La Follette, Tenn. Table mountain pines (*Pinus pungens*) and other xerophytic forms grow on these crags. Most of the species figured here may also be found on neighboring dolomite cliffs, and many of the species or parallel species are to be found in similar locations in northern Michigan.

Tennessee (See *Fig. 7*) and the sandstone areas of northern Illinois (See *Fig. 6*) which are flat and soil-covered, except where exposed to recent river action. These sharp topographic differences may be due in part, but only in part, to glacial influences; differential erosion is certainly a large element in the case. The sandstones of Marquette agree closely with those of Illinois and are largely clothed with forests even to the shore of Lake Superior (see *figs. 8 and 9*).

One of the remarkable results of the study in Tennessee was that the flora of the exposed sandstone crags bore a strikingly close floristic resemblance to the flora of the granite hills of northern Michigan, 700 miles further north. The lichen aspect is much the same, since forms of *Parmelia*, *Umbilicaria* and *Cladonia* (including the reindeer lichen) dominate. Among the xerophytic mosses, *Polytrichum* and *Leucobryum* are found. Other forms found also in the north are the lichens, *Usnea* and *Ramalina calicaris;* the red maple (*Acer rubrum*), the trailing arbutus *Epigaea repens*, the huckleberry (*Gaylussacia resinosa*), the sweet birch *Betula lenta*), and the ground pine (*Lycopodium dendroideum*). Thus the first rock stages are very similar indeed in places which are separated by ten degrees of latitude; it must be borne in mind in this connection that the altitudes involved in Tennessee are but slightly greater than those involved at Marquette. Places of equal altitude could easily be found in Michigan and Tennessee, which would show the resemblances noted above.

The later stages on the sandstone rocks vary somewhat widely in the regions studied. The first character tree on the Cumberland mountains of Tennessee was frequently the table mountain pine (*Pinus pungens*), which may be compared with the somewhat similar scrub pine of the north (*Pinus Banksiana*), which occupies similar habitats. After this, however, the order of succession is divergent in the two regions. Oaks of various species follow the pines in Tennessee, at first the more xerophytic forms, such as the black jack (*Quercus nigra*) and the chestnut oak (*Quercus prinus*), and later the more mesophytic red oak (*Quercus rubra*)and white oak (*Quercus alba*). In many cases the xerophytic oaks are followed by the chestnut (*Castanea sativa Americana*); after these comes a luxuriant mesophytic forest made up of many species, among which may be mentioned the tulip (*Liriodendron*), the buckeye (*Aesculus*), the hickory (*Carya tomentosa*), the walnut (*Juglans nigra*), the magnolia, the beech (*Fagus*), the sugar maple (*Acer saccharinum*), and the hemlock

(*Tsuga*). While, as stated above, the oak and chestnut stages have no counterpart in northern Michigan, it is interesting to observe that the last stage is found there in a perfect development, and is dominated by the hemlock, beech, and sugar maple, three prominent constituents of the mesophytic forests of Tennessee. Thus in Michigan and Tennessee the beginning and the end are alike, or in other words the intermediate stages are eliminated in Michigan. No sure reason for this can now be given, tho it is likely that the northern Michigan climate is unfavorable for the development of oaks and chestnuts, hence the pines can remain until the conditions favorable to the beech and maple appear. As already noted, the oak and chestnut stages are to be found on the granitic hills of Connecticut; it may be added here that they also occur on the morainic hills of Long Island. Hence the stages

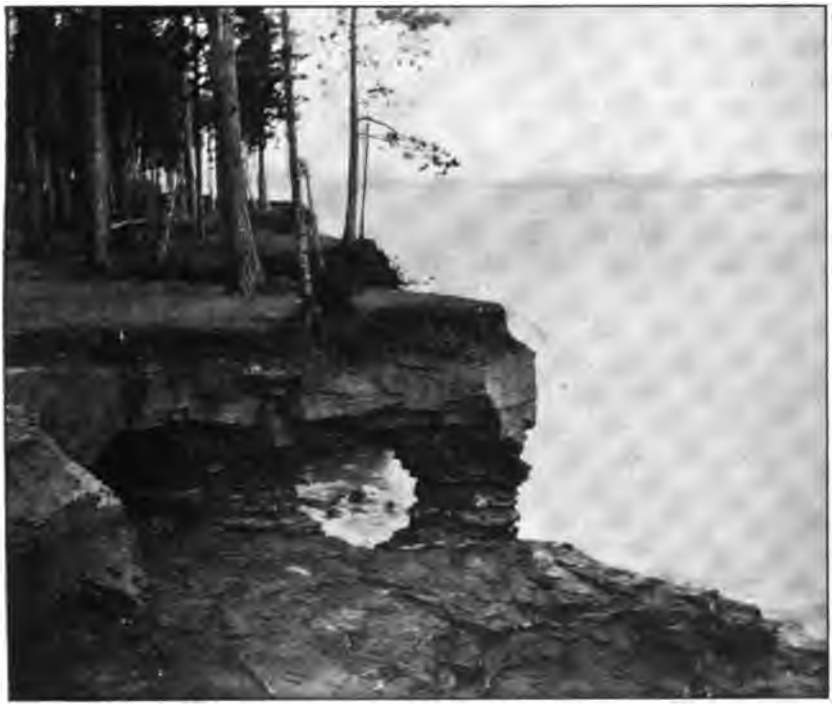

FIG. 8. Erosion cliff of sandstone on the shore of Lake Superior, Marquette, Mich. Pines and other trees are seen on the edge of the cliff, indicating that the sea has encroached.

outlined above, like all other stages, are general and not peculiar to the sandstone.

V. Shales. More than all other rocks, not excluding even limestone, shales are subject to rapid erosion. So true is this that shale hills are almost never seen, and one finds outcrops commonly only along eroding streams or underlying exposures of more resistant rock. Thus, as can be readily seen, the xerophytic phases of shales are extremely ephemeral. Lichen and crevice stages are seldom seen, and the other stages pass so rapidly that most shale areas are covered with mesophytic forests. In the region of the Cumberland mountains of Tennessee, the shale areas are indicated by valleys, just as the sandstone areas already noted are indicated by hills.

VI. Limestones and dolomites. Limestones differ chemically from all the rocks considered heretofore. Hence here it is that those who hold to the chemical importance of soil factors would largely look for data. Pure limestone is ordinarily regarded as made up of calcium carbonate, but since limestones give rise upon decay to siliceous soils, it follows that there must be silicates and other mineral substances present also. In the case of other rocks considered in this paper the residual soils are much like the parent rocks, since the latter are largely insoluble and broken chiefly by physical means. But in limestones the larger part of the rock is dissolved and removed, and only the insoluble residue, largely siliceous, remains to make a soil. Many of the red residual soils of the southern states have arisen in this way, thru the decay of limestone. Dolomites differ from limestones largely in the presence of magnesium. Like limestones they decay largely by chemical agencies, but they are on the whole more resistant. Dolomite hills are more likely to remain xerophytic for a long time, and the final stages will of course come more slowly. In both limestone and dolomite siliceous material in the form of flint or chert nodules is likely to be abundant; as the hill wears down, these accumulate in greater and greater numbers and in many cases cause a serious retardation of the erosive forces.

Lichens are commonly said to shun calcareous districts. An observation of this character is due to the most superficial study. In the first place xerophytic limestone outcrops are much less common than sandstone or granite in proportion to their total area. In the second place limestone when exposed is subject to constant superficial erosion to a degree that is not true of most other rocks, hence it is difficult for lichens to get and keep a foothold there. The limestones and dolomites of Illinois, however, show a wealth of lichen carpeting wherever xerophytic exposures are found. The cliffs along the Mississippi river in Iowa and Minnesota for miles are yellow with the lichen, *Theloschistes*.

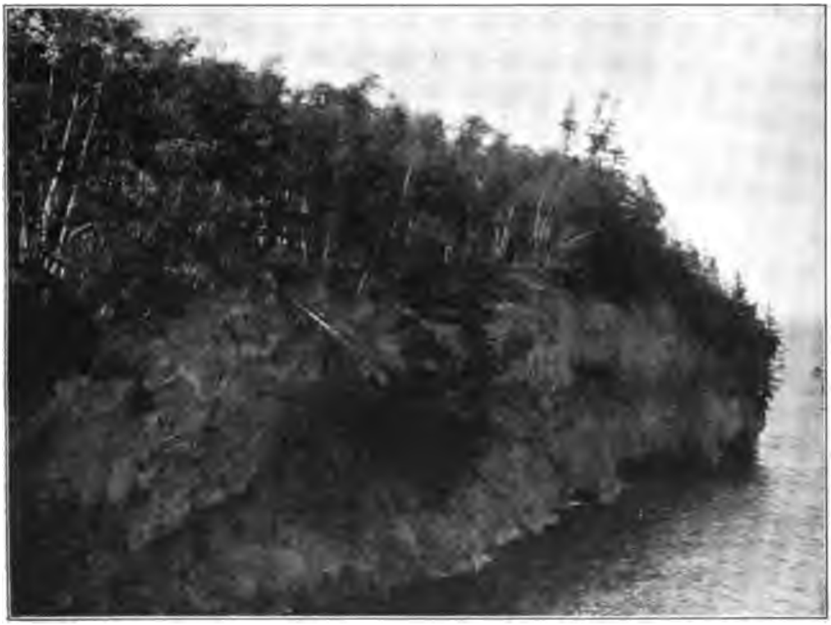

FIG. 9. Erosion cliff of sandstone on the shore of Lake Superior, Marquette, Mich. Pines and birches are seen on the edge of the cliff in full development. A comparison of this cut with *Figure 7* shows the rock to be much less resistant to erosion, or in other words the plant stages pass more rapidly here.

Whatever may be said of the lichen stage, all subsequent stages are quite normal. The crevice stages (see *Fig. 10*) are well developed, and such forms as the harebell (*Campanula*), the cliff brake (*Pellaea*), together with xerophytic mosses are common on the Illinois limestone cliffs. The tree stages are ushered in, as on other rocks, by conifers, and by the same species that are found on siliceous rocks. The conifer stages are beautifully shown on the limestone cliffs near Sturgeon Bay, Wis., and here the species are those of the granite and sandstone of northern Michigan. In Illinois the conifers are those that occur also on the neighboring sandstone, *viz.* the white pine (*Pinus Strobus*) and the red cedar (*Juniperus Virginiana*). Following the conifers in Illinois on both limestone and sandstone are the yellow-barked oak (*Quercus coccinea tinctoria*) and the white oak (*Quercus alba*).

The first stage in the development of a river is the growth of a ravine; in this stage vertical cutting is commonly so rapid as to give a relatively deep and narrow topographic form. In such a place the conditions for plant life are of course quite different from those on a xerophytic bluff. From comparative studies made of sandstone, limestone and dolomite gorges in northern Illinois it appears that stages are essentially alike whatever be the character of the rock. In all cases there is a rich mesophytic flora, essentially alike as to species; in all cases liverworts of many species are abundant, also such plants as the fern, *Cystopteris* and the columbine (*Aquilegia*). The conditions and also the species are much the same in shale and sandstone ravines of northern Ohio and in shale and dolomite ravines of eastern Tennessee.

From the discussions which have preceded, it appears that siliceous and calcareous rocks are in the main alike in the species of equivalent stages. It must not be rashly concluded, however, that there are no differences. A careful investigation of this question was made in Ogle county, Ill., in the spring of 1901. While it was found that most species, and particularly the more characteristic species, grew equally well on either rock (including such forms as the cliff brake, *Pellaea*, usually called a limestone plant), nevertheless a few persistent limestone plants were noted. For example *Sullivantia Ohionis* was found only in limestone ravines; some other species found sparingly on the sandstone were common on the limestone. A much more striking case of the same kind was found in the mountain districts of Montana in the summer of 1901. While the flora of granite, quartzite, basalt and dolomite were largely alike, a limestone area near Lake McDonald yielded most of the common forms of other rocks and also a large number of species that were found nowhere else. While these latter observations were somewhat too hasty to be conclusive, they indicate that chemical agencies may play a part in determining the distribution of rock floras.

In comparing the areas studied, it may be said, in the way of summary, that the various rock species are more alike than unlike during all stages of their history. It becomes obvious why many have hastily concluded that one rock type differs from another; it is because differential erosion has not been considered. In a given region a shale area may be clothed with a mesophytic forest, while a dolomite outcrop is still xerophytic or a quartzite is scarcely more than a naked hill. The relations of the different types are splendidly shown in the Cumberland mountains of Tennessee. There the strata stand vertically, and it is easy to imagine the past and the future of the rocks and their vegetation. Ages ago the strata were exposed and perhaps all alike, sandstone, shale, dolomite, and limestone, were essentially at a common level, and on all alike there began to develop the first xerophytic stages. As

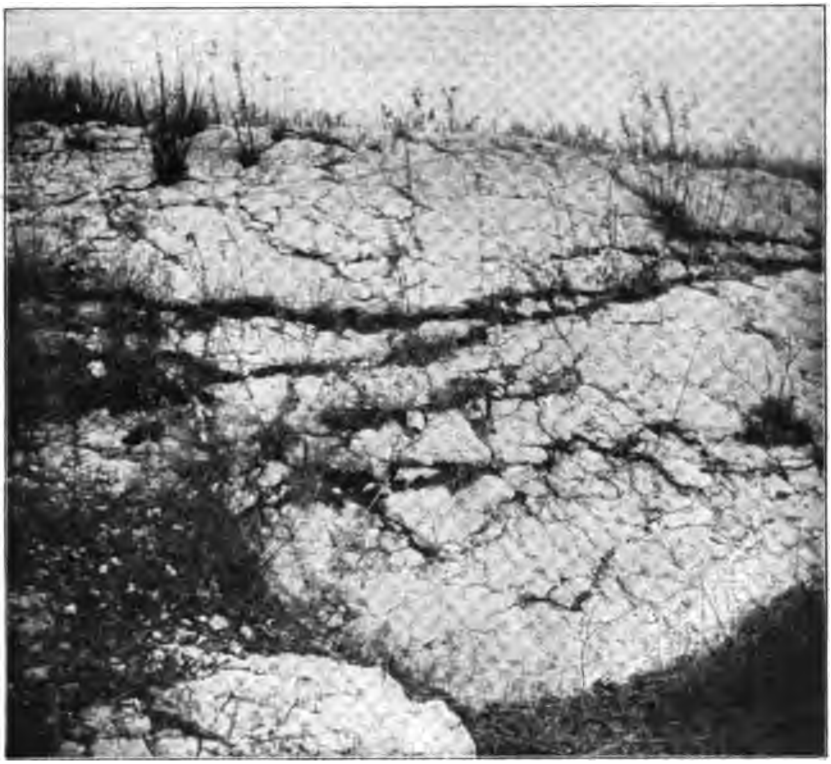

FIG. 10. Cliff in dolomitic limestone, Chicago, Ill., showing the beginnings of crevice vegetation. Lichens occur at this point and the vegetation resembles that of similar exposures of sandstone or limestone proper.

time went on the shales, thru easy mechanical disintegration, and the limestone, thru easy chemical decay, eroded more rapidly than the more stable dolomites and sandstones. Thus the dolomite and sandstone areas became hills and remained xerophytic, while the limestone and shale areas became valleys and hence were clothed with mesophytic forests. Looking into the future it is easy to see that the valleys will become deeper, thereby making the hills relatively higher and more xerophytic, only until the valleys reach their final level. Then the sandstone and dolomite hills will wear away relatively as well as absolutely, and all areas alike will become mesophytic as all alike were xerophytic at the start.

Contributions from the Hull Botanical Laboratory, the University of Chicago. XXXIV.

EDITORIAL

Announcement At a recent meeting of the Editors of the Journal of School Geography and of the Bulletin of the American Bureau of Geography, arrangements were completed whereby these two periodicals will be combined and published under a new title. The Journal of School Geography, edited by Professor Richard E. Dodge of Columbia University, has been issued regularly since 1897. It has been devoted to the advancement of geographic education in America and has steadily maintained a high standard of excellence in all of its departments. The Bulletin of the American Bureau of Geography, like its colleague, has been devoted to the interests of geography teachers; and since its first appearance in 1900, it has enjoyed a wide circulation and a generous support. The combination of the Journal and the Bulletin gives an opportunity for united effort full of promise of large and gratifying results.

The responsible editors of the new journal are Professor Richard E. Dodge of Columbia University, Dr. J. Paul Goode of the University of Pennsylvania, and the Editor of the Bulletin of the American Bureau of Geography. These will be assisted by a strong board of Associate Editors representing practically all of the larger divisions of geography.

The new publication will be called *The Journal of Geography.* It will be an illustrated magazine with 480 pages to the volume, and will be published monthly excepting July and August. Notwithstanding the increase in size, the annual subscription price will remain as now, $1.50, and subscribers to the Bulletin will be continued on the mailing lists for their full time without additional charge. Subscribers to the Bulletin who are also taking the Journal of School Geography will have their subscriptions extended as many numbers beyond the current issue as they would otherwise have received of both of the older publications.

The Journal of Geography will be issued for the first time in January. Like its predecessors, the new journal will be devoted to the advancement of geographic education, and its enlarged opportunities will enable it to widen its field and to increase its usefulness.

The Editor is grateful to the friends of the Bulletin for their many helpful suggestions and for their generous support. He trusts that the new plans will meet with their complete approval, and earnestly hopes for their continued co-operation in the new enterprise. E. M. L.

Suggestions to Teachers Field work is constantly growing in favor. Provision should be made to increase it and make it more effective. One of the practical helps is for the principal to take charge of it and go with the regular teacher of the class; then a whole class can be easily taken at once with the greatest economy of time and energy.

Egypt is always a most fascinating country. Children never tire of an imaginary ride up the Nile in a dohobeah. The teacher will find all needed help in conducting the journey, in the recent publications by Steevens, Boddy and Fuller. Charles Dudley Warner's well known "A Winter on the Nile" is most enjoyable as well as Prince's "Boat Life in Egypt." Mrs. Lee Bacon's "A Houseboat on the Nile" which describes a trip between the first and second cataracts, tells of very recent experiences in a charming way but is less valuable for the teacher. One of the best books for the teacher is Miss Edwards' "A Thousand Miles up the Nile."

In the *Photo Era* for October 1901, is an interesting communication upon teaching English with the camera. A very wide awake teacher of a ninth grade has gone out with her pupils at noon and taken pictures, and even developed the plates in the basement after dark, before the class. The pictures were afterwards printed on blue print paper and used to illustrate compositions. The *Photo Era* approves of an elementary course in school photography and gives directions for carrying it out. We most heartily approve of all this except the developing before the class which shows more enthusiasm than wisdom. The camera is certainly most helpful in the hands of the geography teacher, but the time has hardly come to give pupils in a grammar school instruction in the difficulties and expenses of good photography. There are several other little matters which need previous attention. The schools are already overburdened with too many subjects to teach.

The series of articles on "Eighth Year Geography" now appearing in *The School News* published at Taylorville, Ill., should not be missed by any wide-awake teacher of geography. Several papers in the series have already appeared: The Study of the Map; The General Atmospheric Circulation; and The Geography of Europe.

Current literature is full of articles on South Africa. One of the very best books on this country is one recently written by Prof. Bryce. It gives the teacher all necessary information.

Teachers taking special subjects like geography to teach, must be careful and not overdo, or think that they can work without proper rest, outdoor exercise and sleep. We have just heard of a case of a fine geography teacher who suddenly went all to pieces because she overtaxed her nervous strength in and out of school.

Send the children out to observe nature and report. One hour in the field is worth ten hours over definitions which have no meaning to the young mind.

Where text-books are supplied by the city or state there is great educational advantage and no increase of expense in allowing the schools to have several different series of books. In this way every child will have a different geography each year of the study. This common sense arrangement has been possible in Brooklyn for years, but rarely in other places. Why not? Can there be given a good educational reason?

There is plenty of good geography around every school building if the eyes are only open to see it.

In writing out the account of observational lessons, originality of language and the order of the description should be expected so as to have no two accounts alike. The teacher must be careful and not do too much of the work even in a third or fourth grade.

Spelling lessons in geography are always in order.

The blackboard is rarely used too much in connection with geography. K.

NOTES

The Mississippi River Basin The Mississippi River basin contains 1,250,000 square miles. If the river were under control, bottom lands along the lower part of its course could be cultivated that would give the South one million acres more of the best corn land, two and one-half million acres more of fine sugar land, and seven million acres more of what has been called the "best cotton land in the world." That is, ten and a half million acres, or about 16,400 square miles, of the best quality of land would be added to the agricultural area of the United States. This means that the corn, cotton, and sugar growers would be given a rich additional acreage equal to the combined areas of Massachusetts, Connecticut, Delaware, and Rhode Island, with over three hundred one-thousand-acre plantations beside; or, they would be given an added acreage considerably greater than the whole area of either Switzerland or the Netherlands. The net money value of the corn, cotton, and sugar crop raised on this added area of ten and a half million acres may be more easily calculated than comprehended.

Again, the Mississippi river carries away in suspension, and along its bottom to the Gulf of Mexico an annual deposit equivalent to a square mile of land 270 feet deep. Or, every four years, the Mississippi river could cover with a fine deposit, a foot deep, the state of Rhode Island and the District of Columbia. There would then be enough deposit left to give one hundred 100-acre farms a soiling of the same depth. It should be remembered that this vast deposit waste, piling up in the Gulf of Mexico, would make an acreage as above stated of less than a fifty-sixth part of the rich territory lying idle along the course of the great river. The total loss, in bottom lands agriculturally inaccessible, is less than one seventy-fifth of the area of the entire Mississippi basin. This, tho, means that, so often as every third generation, man suffers an industrial loss equivalent in acreage to the whole region that has been recognized as "the granary of the world."

The carried deposit may long remain a seemingly sacrifice gift to the Gulf; but, these corn, cotton, and sugar lands of the southern states lie there a majestic, unwithdrawn invitation to the industrial power and ingenuity of man, which when it succeeds, will receive its great reward. ALLEN P. BROWN

Survey of British Lakes

At the annual meeting of the British Association for the Advancement of Science held at Glasgow in September last, it was announced that means for making a complete bathymetric survey of all the lakes of the British Isles have recently been provided by a munificent private benefaction. The lakes will be sounded and mapped, the character of their deposits and waters ascertained, and their fluctuations observed, while a complete biological and geological examination will also be carried out.

The funds for this purpose are given by Mr. Lawrence Pullar of Perth, as a memorial to his son, the late Frederick Pullar, who for some time previous to his recent death was engaged in bathymetric investigations in the "lochs" of Scotland in conjunction with Sir John Murray, formerly naturalist to the "Challenger" expedition, under whose able direction the proposed survey will be made. The results will doubtless constitute a magnificent advance on the present knowledge of the physical geography of the British Isles as well as an important contribution to various departments of science. J. A. D.

Discoveries in Ancient Babylon

The German Oriental Society has for two years been carrying on excavations in ancient Babylon, and with remarkable success. They have shown that the ancient city had a length of about seven miles, which is very much smaller than reported by Herodotus. The great citadel, which was the palace of Nebuchadnezzar, and the place in which Alexander the Great died, has been identified. It was one of the world's greatest structures, having walls from forty to a hundred feet in thickness.

To Navigate the Garonne M. Rossignol, professor of history and geography in the University of Bordeaux has organized a society whose purpose it will be to make a canal of two metres depth from Castets to Bordeaux, and from the Garonne to the Loire.

Latest Census of Austria-Hungary and Italy At the beginning of the current year the census gave a total population of Austria 26,107,304 and of Hungary, 19,203,531, an increase of 9.3 per cent. and 9.96 per cent. respectively.

The population the ninth of February in Italy was 32,449,754 an increase of 7.3 per cent.

Production of Caoutchouc in Africa It is not generally known that the production of caoutchouc is rapidly increasing in Africa, in the Congo Free State, in the Kameruns, and along the West Coast to Senegambia. A map recently prepared by Dr. E. Friedrich shows the distribution on the west coast to extend nearly 3,000 miles from north to south, and reaching well across the continent in the region of the Equator. The production in 1898 was valued at over $18,000,000.

The Potato in Europe A study of potato cultivation and consumption by the Swedish statistician, G. Sundbärg, shows that the United States is one of the smallest producers of the tuber. Europe at large planting more than ten times the acreage of America. In Holland 15 per cent of the arable land is planted to potatoes. Switzerland has 14 per cent.; Belgium 13 per cent.; Germany 12 per cent.

Life Saving Service During the past year our life saving service has shown an enviable record. Only one life was lost to every forty-three casualties, while the average for the past twenty-five years is one life for every thirteen casualties. Property was saved to the value of $6,403,035 and only $948,965 was lost.

REVIEWS

A Text-Book of Commercial Geography.—By Cyrus C. Adams, B. A., F. A. G. S. 12 mo., 540 pages, cloth, illustrated. 1901. Price $1.30. D. Appleton & Company, New York.

This work on Commercial Geography is one of the series of Twentieth Century text-books. In its general make-up, paper and typography, it at once creates a favorable impression; and an examination of the table of contents and a careful study of the text more than strengthen this first impression. The work is not only thoro but evinces in the elucidation of each topic and in the discussion of each product and country that the author has a clear comprehension of geographical conditions in their relation to these subjects. Furthermore, the book is a veritable mine of facts, both geographical and commercial, and shows at every step the author's careful research work in the preparation of diagrams, statistical tables and distribution maps.

We can heartily commend the book both to the general reader and to teachers and students.

H. Justin Roddy

Lessons in Physical Geography.—By Charles R. Dryer, M. A., F. G. S. A., Professor of Geography in the Indiana State Normal School. 12 mo., half leather, 430 pages, illustrated. 1901. Price $1.20. American Book Company, Chicago and New York.

In this new work on Physical Geography the author divides his subject into five parts or books,—*the planet sphere* including the centrosphere, the *lithosphere*, the *hydrosphere*, the *atmosphere*, and the *biosphere* or life sphere. Each of these is well presented, and the clearness of the pupil's conceptions of the subjects in each is much enhanced by realistic exercises judiciously introduced and clearly stated,

The author properly thinks that in public school work not all the physical features of the earth can be presented so that a selection of representative type forms is rendered necessary for thoro study. In these the facts are vividly portrayed, and then the proper generalization is carefully and clearly stated. Books for reading and consultation are also suggested so that advanced work may be done by pupils who are above the average in ability or capacity for work.

The book is not only suggestive and interesting—it is teachable and will without doubt inspire in pupils and public school teachers a lasting interest in the most valuable study of the public school curriculum.

H. Justin Roddy

Introduction to the Study of Commerce.—By Frederick R. Clow, Ph. D. 12 mo., 224 pages, 1901. Silver, Burdett & Co., New York.

This book was written to meet the growing demand of colleges and the best secondary schools for a systematic treatment of the subject of commerce. The first six chapters deal with the elements and materials of trade, the foreign and domestic commerce of the United States and other countries, and the organization of trade. Three chapters follow on the mechanism of exchange. The last chapter discusses "Practical Devices for Promoting and Regulating Commerce."

The book is not a commercial geography. It deals with the materials and methods of commerce and with the principles which underlie exchange, rather than with the physical features as determining production or the processes of the agricultural and manufacturing industries. In other words, the author's point of view is that of the economist rather than that of the geographer. The book should nevertheless serve as a wholesome check upon those teachers who seek the final explanation of all things in physiography, and should prove an excellent means of introducing the student to the principles upon which trade rests.

The method of the book is rather out of the ordinary. The plan of introducing each topic by a series of questions intended to develop it, may not meet the approval of all teachers, tho it does that of the present writer. The method of setting specific work for the student, as is done at the end of each section, makes of the book an excellent working manual. The volume is well printed on heavy paper and strongly bound in cloth. G. O. Virtue

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Commercial Geography.—Smaller edition. By George G. Chisholm, Fellow of the Royal Geographical and Statistical Societies of England. New Edition, 1898. Small Octavo, cloth bound, price 90 cents. Longmans, Green and Co., Publishers. New York and London.

This volume is in the main an abridgment of the author's "Handbook of Commercial Geography." The principal matter of the larger volume, in which the leading facts of international commerce are presented, has been retained, but the description of countries has been suitably condensed and in the main confined to those features which are of importance as regards the commerce of nations. Naturally, a great deal of attention is devoted to the commerce and industry of the British Empire, but the treatment of other countries is quite as full and satisfactory as one may expect to find in a book of two hundred pages.

The principal commodities of the world, the conditions affecting their production, such as climate, temperature, moisture, cost of land, labor, etc., are first taken up. Then follows a discussion of the chief mineral products of the earth, and a brief account of the manufactured articles of commerce. The remainder of the work is devoted to the principal countries of the globe and the part which ach plays in the world's commerce. The appendix brings a list of the principal colonial possessions of the European countries, also a table of railways, a comparison of ocean routes, and a table of areas, population and exports of the principal countries of the world. W. Paul Gerhard

Boston Edition of the Perry Pictures.—The Perry Pictures Company of Malden, Mass., with their usual progressiveness have just brought out something new in the Perry Pictures. To distinguish the new pictures from their regular edition, they call them the Boston Edition of the Perry Pictures.

The Boston Edition are like the Extra Size Perry Pictures except in size. They are on rough paper 5½ by 8 inches and in that beautiful sepia tone that is so popular in the Extra Size. Altho the pictures in the Boston Edition are more expensive to the publishers they have decided to send them in the subjects in which they are now furnished at the same price as the regular edition, one cent each for 25 or more, 120 for one dollar. All orders for the Perry Pictures, one cent size, will be filled with the Boston Edition, as far as the subjects ordered are being furnished in the new edition, without extra charge. Many subjects are now ready and more will follow rapidly. One who has not seen them does not realize the artistic beauty of these pictures.

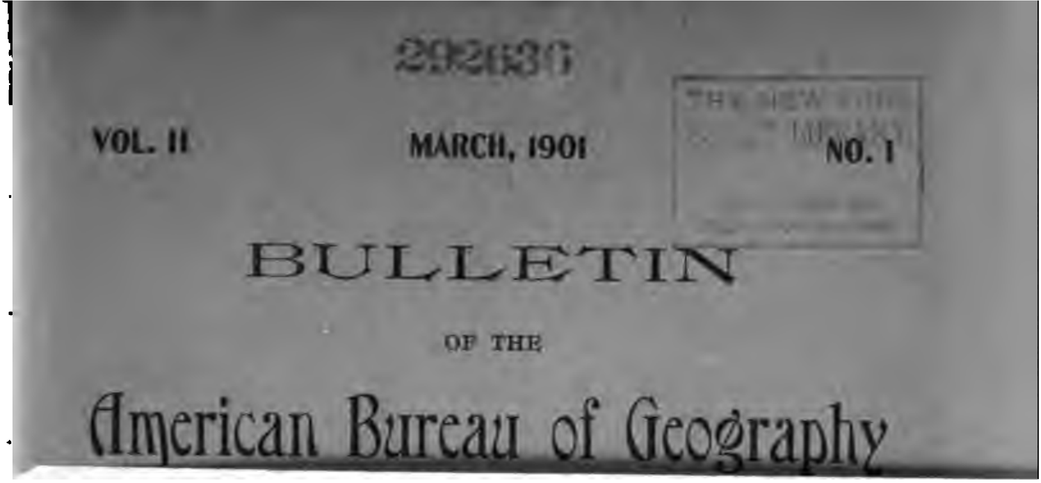
Map of Germany.—Columbia series, 66x46 inches, mounted on heavy cloth. 1901. Rand, McNally & Co , Chicago.

This map of Germany is a recent addition to the Columbia series of wall maps prepared expressly for public school use. The physical features of the country are well brought out, the mountains, rivers, lakes, and waterways being correctly shown. The Emperor William Canal which was but lately opened with a naval demonstration at Kiel, indicates that the map contains the latest information available.

In addition to Germany, the map shows parts of the Netherlands, Belgium, France, Switzerland, Austria-Hungary, Russia, Denmark and Sweden. The states and provinces of Germany are clearly distinguished by different colors, the whole effect being unusually pleasing. It will be of interest to know that to secure the desired color effect the map had to pass through the press nine times.

Geography teachers in Iowa are to be envied the series of Reports on the Geology of the separate counties, by Samuel Calvin and H. Foster Bain, of the Iowa State Geological Survey. The latest issue, the Geology of Dubuque county, is a separate of 266 pages from the Annual Report of 1899, and is a model of what such a report should be. The physiography and stratigraphy are given in detail, with beautiful contour maps of high value. In the economic geology, which is given in detail, will be found an excellent account of the zinc and lead industries of the upper Mississippi valley.

Under the title "A Handbook of Trade, Industries and Production" Oscar Halvorsen of Windom, Minnesota, issues a neat little pamphlet of 66pp filled with the latest statistics of commerce. Sources are indicated and dated. It is a valuable summary, and will be appreciated by many teachers who want to get the "last word" in statistics.



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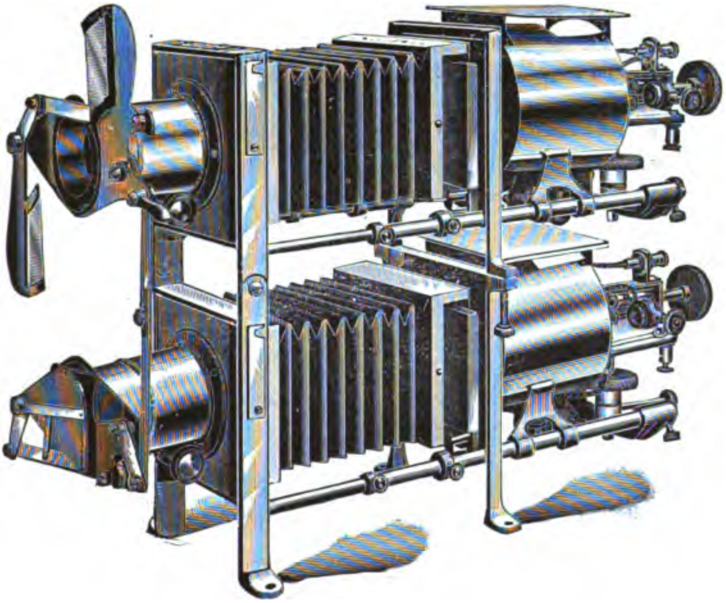

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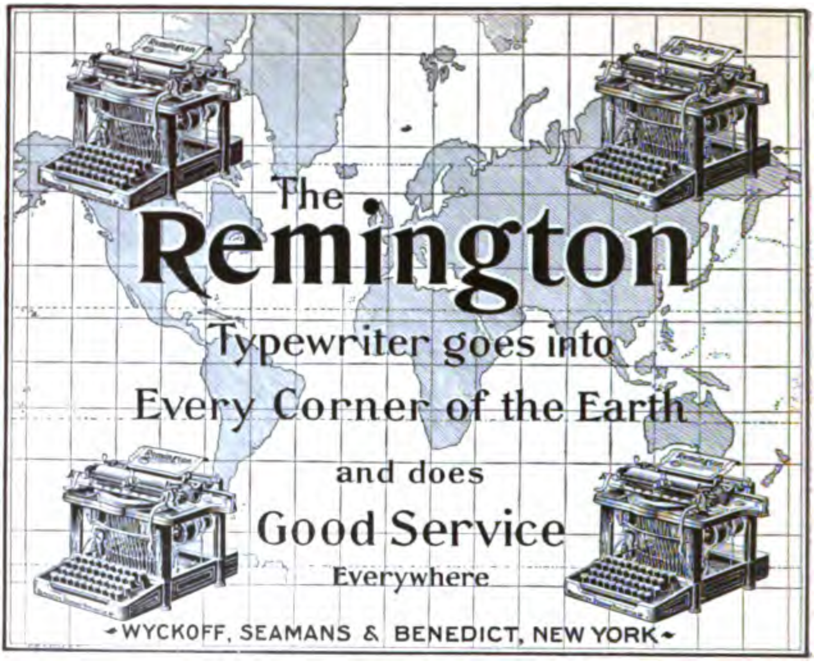

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